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The Course of Oil

By THE EDITORS

Opposition to Federal Oil Bill Growing

Introduced only on July 26, and then merely for purpose of "study" until the next convening of congress in January, the Federal Oil Bill already is meeting with strong opposition on the part of the petroleum industry. Although avowedly designed solely as an oil and gas conservation measure having the purpose of developing the fullest coöperation between state and federal officials, the measure is looked upon by many as providing the government with an "entering wedge" that eventually would lead to complete federal regulation of the industry. Some have gone so far as to express the belief that this bill in itself would delegate sufficient power to bring about such a result.

By the terms of the bill an office of petroleum conservation would be established in the U. S. Department of the Interior, under the direction of a commissioner. The commissioner would be appointed by the president and assisting him would be two assistant commissioners appointed by the secretary of the interior. Deputy commissioners, experts, and other employees also would be appointed by the secretary of the interior. The duties of the commissioner would be to investigate all fields within the United States to determine if the methods employed in oil recovery are of such a nature as to prevent avoidable physical waste of crude oil and avoidable waste of reservoir energy.

Physical waste of crude oil is deemed to include "the loss or destruction of crude oil after recovery thereof such as to prevent its application to useful purposes, and the entrapment or isolation of crude oil through irregular or premature encroachment of water, the loss or dissipation underground of crude oil or natural gas, and the premature release of natural gas from solution in crude oil, all such as to render impracticable the recovery of such crude oil."

Waste of reservoir energy would be considered to include "the use or dissipation of such energy, either as gas energy, hydrostatic energy, or other natural energy, at any time at a rate or in a manner which would result in the exhaustion of the energy available for the recovery of crude oil prior to the recovery of the ultimate quantity of crude oil which such energy would be or might be made effective in recovering or rendering recoverable. Reservoir energy available for the recovery of crude oil shall be deemed to include that natural energy existent in any deposit containing crude oil in the recovery of which such energy may be made effective."

Wherever methods and practices employed are considered by the commissioner to foster waste he would have the power, upon failure of the operators in the field to agree upon a plan that would eliminate avoidable waste, to himself promulgate necessary regulations. Moreover, in event of an agreement among the operators, which, incidentally, must be approved by the commissioner he (the commissioner) has authority to make any additions he may think advisable. Further, if at any time after his approval of the agreement among operators the commissioner shall find that the agreement is not effective in lieu of regulations, he may promulgate such regulations and rescind his approval of the previous agreement.

This portion of the bill (Section 7) would seem to make the commissioner the final authority in determining what is "good practice." Despite an introductory statement that the bill is "to provide for coöperation with the states in preventing the waste of petroleum," apparently the commissioner's decisions would take precedence over those of any state regulatory body, which, in effect, would be federal control pure and simple and not a mutual coöperative effort between state and federal bodies.

A few months yet remain before the Federal Oil Bill can be considered for congressional action. Perhaps in the interim it might be well for those states who have withheld their fullest coöperation in the matter of regulating oil production to give thought to the weakened position in which they could place proponents of the Federal Oil Bill by forgetting personal selfishness and acting to place the industry within those states on a self-controlled basis. The most effective argument against any proposed law is to demonstrate that it is not needed.

Compact Members Express Concern Over Illinois

Concern over unregulated oil production in Illinois was expressed at the two-day quarterly meeting at Santa Fe, New Mexico, of the Interstate Oil Compact Commission. Members of the commission, whose principal interest is prevention of waste by regulation, are justly fearful that continued uncontrolled production in that state will jeopardize all attempts to stabilize the industry.

This is not the first time concern has been expressed over the Illinois situation. The fact that the recent meeting of the Interstate Oil Compact Commission was devoted largely to a consideration of this one problem, however, would seem to indicate it is looked upon as a factor of growing importance. Statistics bear out this cause for concern. When the compact commission last met in March, Illinois' daily crude oil production was 175,000 barrels. Latest figures issued by the American Petroleum Institute reveal that the production at present is 279,500 barrels per day.

Illinois is a member of the Interstate Oil Compact Commission. It does not, however, have statutes regulating oil production. With production increasing at such a rapid rate it seems apparent that such a condition cannot continue indefinitely. Perhaps the investigation now being made by the state legislative committee will result in the correction of this growing evil.

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« « HIGHLIGHTS IN OILDOM » »

Petroleum Prospecting in New Guinea

Prospecting for Petroleum in New Guinea, Netherland India, is making only slow progress and is costing much money. According to a recent report of the Nederlandsche Nieuw-Guinee Petroleum Maatschappij, which was formed in 1934 by the Bataafsche Petroleum Mij. (Royal Dutch), the Nederlandsche Koloniale Mij. (Standard-Vacuum), and the Nederlandsche Pacific Petroleum Mij. (Standard Oil Company of California), and has been operating in Netherland New Guinea since 1935, the Nederlandsche Nieuw-Guinee Petroleum Mij. had expended to the end of 1938 about $8,250,000. Approximately 80 test-holes have been drilled to depths between 165 and 2300 ft. on the island of Salawati, and near Sele, Karabra, and Metamani on the south side of the Vogelkop Peninsula.

On the basis of the results obtained to date the Netherland New Guinea Petroleum Company has now begun deep drilling in two places on the south side of the Vogelkop Peninsula, one in the Wasian River district known as Wasian 1, and the other about nine miles from the Strait of Sele known as Sele 38. The preparations for this type of deep drilling cost considerable time and money, as it is by no means simple to set up a modern rotary rig and maintain it in uninterrupted operation. It is necessary to transport, in the almost trackless country, from 1000 to 1500 metric tons of material, of which some single pieces weigh as much as ten tons. Along with a personnel of about 150 whites and 800 natives the company maintains for its present operations alone five motor freight-vessels, eight large barges, 50 lighters, 25 motor boats, and a large fleet of trucks, as well as various narrow-gauge locomotives and railways, and a number of airplanes.

If it succeeds in obtaining a good oil field in the next three to five years, there will be further large expenditures through the construction of pipe lines and other installations; but it is still quite uncertain whether the production will prove remunerative in the long run.

●

Impetus Given Water-Flooding in Oklahoma

Recent orders by the Oklahoma State Corporation Commission have given impetus to water-flooding of shallow pools in northeastern Oklahoma. In a report accompanying permission for the Albion Oil Company to water-flood a lease of about 350 acres in Rogers County, the commission placed its stamp of approval on water-flooding as a conservation measure. The commission pointed out that the company has about 40 wells on the lease and that under existing conditions they do not produce enough oil to justify their operation. As further justification for granting the petition the commission cited the results of its having granted similar permits to the Wellsville Oil Company and others in the area. Leases in Rogers County that have been water-flooded are now producing oil that would not have been recovered, it states, and the practice has proved to be "in full accord with the conservation policies of the commission."

Another flooding project authorized by the commission is that of Harmon and Whitehill, Inc., of Nowata, Oklahoma. This company asked for permission to water-flood properties on which there are 110 wells, all of which are of an approximate depth of 500 ft. Total production of the 110 wells on the pump is only 70 bbl. per day.

●

Compact Commission Discusses Illinois Situation

Unregulated oil production in Illinois was a principal topic of discussion at the two-day quarterly meeting of the Interstate Oil Compact Commission in Santa Fe, New Mexico, recently. Members of the commission saw in the Illinois situation a threat to attempts to stabilize the oil industry.

Dr. A. H. Bell, head of the Oil and Gas Division of the Illinois Geological Survey, in a talk discussed the development in Illinois production since the last meeting of the commission in March. At that time the state's production was 175,000 bbl. per day. When Bell made his talk the daily production was 261,000 bbl. Most of the increase has been from the Salem field, he said.

Clint Small, state senator from Texas, stated that oil operators in Illinois "violate the very conservation principles they pretend to raise in Texas." He implied that retaliatory measures might be taken against Texas companies operating in Illinois without restraint, saying: "Illinois has no control legislation and companies that have been preaching conservation in Texas are going to Illinois and doing the exact opposite. They will have a hard time explaining their position back in Texas."

Selection of the place for the next meeting of the commission has been left to Chairman Thompson.

●

Favors Another Three-Month Order for Texas

Lon R. Smith, chairman of the Texas Railroad Commission, in announcing the next state-wide oil and gas proration hearing, has declared himself in favor of another three-month order. The existing order was issued for the months of July, August, and September and continued the policy of week-end shutdowns.

Smith's declaration for another three-month order was designed partly to quiet rumors that the commission would revise its current order to conform with the federal court decision in the Rowan and Nichols case.

In making his statement, Smith said in part: "The railroad commission will take no cognizance of the Rowan and Nichols case until after the federal court to which it has been appealed acts. I am in favor of another three-month order, for I believe it is very helpful and adds stability. The people then know what to expect and what to do."

With the commission delaying cognizance of the case pending the appeals court ruling, Smith pointed out that in event an adverse judgment is given the proration order could be revised to conform. He said, however, that in the meantime no change is contemplated in the existing order. The current order made an exception as to the Rowan and Nichols' East Texas lease to conform to the federal court order, which increased from 110 bbl. to 220 bbl. the allowable for a 25-acre lease adjoining which a well had been drilled on a fraction-acre tract.

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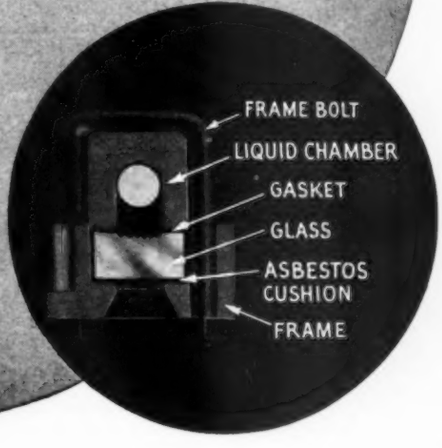

Activities in Refining

Percent Refining Capacity Operated

Western Division, 68.3 Percent **Central Division, 83.5 Percent** **Eastern Division 92.2 Percent**

THE Shallow Water Refining Company is constructing a 750-bbl. cracking and reforming unit to supplement its 3000-bbl. skimming plant 25 miles north of Garden City, Kansas, according to a recent announcement by C. L. Crenshaw, manager. The new unit will make possible the manufacture of 70-octane gasoline as well as third grade motor fuel. Until now the latter has been produced exclusively.

●

A charter has been granted the Tydal Refining Company, Inc., new operators of the Tydal refinery southeast of Gainesville, Cooke County, Texas. The plant, which was constructed in 1936, has been shut-down for a year.

Incorporators of the new company are J. Curtis Sanford, president; Mac Hall, vice-president and general manager, and J. E. Smith.

The refinery will be improved and enlarged, it is announced. The owners are considering the addition of a cracking unit and the laying of a pipe line to the T. C. U. and Voth pools in western Cooke County.

●

A contract for the construction in the Agua Dulce field, Texas, of a 150,000,000-cu. ft. recycling plant has been awarded to the Stearns-Rogers Manufacturing Company by Clyde H. Alexander, John R. Sherrin, and Robert T. Wilson. Alexander and his associates recently entered into a contract with the Union Producing Company for approximately 8000 acres in the field, and 35 producing distillate wells. The wells are producing from the Bentonville-Comstock and Schroeder sands. Under terms of the agreement, Alexander and associates will drill 35 additional wells, to depths from 4700 to 6600 ft. Three of the wells will be drilled to the Schroeder sand, 27 to the Bentonville-Comstock sand, and six will be input wells. It is estimated the wells will cost $1,400,000 to drill, and the cost of the plant is expected to total $2,000,000.

A modernization and enlargement program involving the expenditure of about $8,000,000 has been announced by the Shell Oil Company for its refinery at Wood River, Illinois. The new work is already under way. When completed the refinery's capacity will be increased from 50,000 to 75,000 bbl. per day.

Plans include the building of a new compounding house for blending and packaging lubricating oils; a new cracking unit of 18,000-bbl. capacity; a plant for the manufacture of high-octane base material for high-test motor fuels, and enlargement of the coking plant.

●

Announcement is made that a recycling plant having a capacity of 66,000,000 cu. ft. of gas per day will be constructed by Davis and Company, Inc., Houston, Texas, in the East Alice field, Jim Wells County, Texas. Davis and Company recently closed a deal with leaseholders in the area. The plant will be erected either on the S. E. Ingram 240-acre tract or on the north end of the Dr. A. O. Cook 700-acre tract, which is near the center of the producing area. Production to be processed will be from the 5150-ft. sand.

●

The Barnsdall Refining Corporation, Tulsa, Oklahoma, is making improvements to its refineries at Wichita, Kansas, and Corpus Christi, Texas, President O. L. Cordell announces. A Universal Oil Products midget polymerization plant is being built at Wichita, which will have a capacity of approximately 1,500,000 cu. ft. of gas per day. At Corpus Christi an atmospheric distillation unit is being erected. This will have a crude oil capacity of about 10,000 bbl. per day.

●

The Shell Oil Company is constructing an absorption-type natural gasoline plant in the Magnolia field, Arkansas. The plant will have a capacity of 15,000,000 cu. ft. of gas per day and will manufacture both natural gasoline and butane. Production of the plant will be shipped by tank car to Norco, Louisiana, where Shell has a refinery.

Crude Runs to Stills, Gasoline, Gas and Fuel Oil Stocks
Week Ended July 29, 1939

A.P.I. Figures
(Figures in thousands of bbl. of 42 gal. each)

DISTRICT	Percent Potential Capacity Reporting	Daily Average Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks	Total Gas and Fuel Oil Stocks
East Coast	100.0	563	91.5	20,644	20,452
Appalachian	85.9	116	90.6	3,299	714
Ind., Ill., Ky.	89.5	485	94.4	12,425	6,869
Okla., Kans., Mo.	81.6	255	74.6	6,571	4,402
Inland Texas	50.3	125	78.6	1,630	2,208
Texas Gulf	89.5	843	94.2	9,653	11,966
La. Gulf	97.3	136	93.8	2,183	2,951
No. La. & Ark.	55.0	42	76.4	523	897
Rocky Mt.	54.2	44	68.8	1,303	680
California	90.0	505	67.8	14,536	94,674
Reported	85.8	3,114	85.0	72,767	145,813
Estimated Unreported		346		5,120	3,140
*EST'D TOTAL U. S. JULY 29, '39		3,460		77,887	148,953
*EST'D TOTAL U. S. JULY 22, '39		3,395		77,960	108,401
U. S. B. of M. *JULY 29, 1938		**3,221		76,977	143,254

*Estimated Bureau of Mines' basis.
**July, 1938, daily average.

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Activities in the Oil Fields

FOUR miles northeast of Otis in Barton County, Kansas, No. 1 Pospishel, drilled by James A. Brouk, et al., in NE NE SE 20-17-15, produced 230 bbl. in 24 hours from the Arbuckle limestone at a depth of 3573 ft. after an acid treatment of 2000 gal. This discovery opens the possibility of a new pool for Kansas.

●

Allied Materials Company's No. 1 Tipken, C SW NW 15-13-6, Lincoln County, Oklahoma, produced initially 17 bbl. per hour on the pump from the Wilcox at a depth of 4271-96 ft.

●

Harold B. Opp's No. 1 Jackson, NE Section 41-LL-T.C.R.R. survey, Schleicher County, Texas, has opened the county's second pool, pumping 50 bbl. per day from the Cisco limestone at a depth of 4049-81 ft. after an acid treatment.

●

A small gasser in the Lake Bisteneau district, Bienville Parish, Louisiana, indicates for the first time that the Cotton Valley stratum of the lower Marine formation is productive in this field and may yield larger wells if thicker sections of the zone are discovered. Potential of the well, Arkansas Fuel Oil Company's No. 2 Gayoso, in section 14-16n-10w, is 3,200,000 cu. ft. per day.

●

During the last half of 1939, total completions of oil, gas, and dry holes in Texas amounted to only 4752 wells compared to 6452 in the same period of 1938, a decline of 26 percent.

The East Texas field accounted for more than half of the decline in the state, having only 261 completions as compared with 1128 in the first six months of 1938. All other districts, excluding East Texas, completed 4491, a decrease of 833 wells, or 15.6 percent.

No. 1 Clemmer, wildcat drilled by Lerke and Whorton, Wichita, Kansas, in C SW of 21-13-15e, northwest of Independence, Montgomery County, Kansas, filled with 800 ft. of oil after the cement plug was drilled. Potential is estimated at 100 bbl. per day, the well producing from a depth of 1536 ft. in the Arbuckle limestone. This represents a new pool as it is over one and one-half miles to the nearest production.

●

Helmerich and Payne's No. 1 Hamilton County Land Company, a wildcat in NE SE SE 6-4s-7e, Hamilton County, Illinois, drilled to a total depth of 3524 ft. in the McCloskey lime, has a good show of oil saturation that promises commercial production when drilled-in and possibly acidized. The well will open up possibilities for a pool in a hitherto unproductive area.

●

Production in a wildcat three and one-half miles from production extends considerably the probable area of the K.M.A. field, Texas. The well, No. 1-CC W. T. Waggoner, drilled by Consolidated and D. E. Hepler, is in the southeast corner of section 36, block 6, H. & T. C. survey, Wilbarger County, Texas.

●

Nation Oil Company's No. 2 Belva-McIntosh, section 31-3s-8e, Mills Shoal township, White County, Illinois, produced initially 1000 bbl. in 24 hours from the Aux Vases formation.

No. 1 A. P. Bump, drilled by C. D. Neff, section 9-2s-13w, Keensburg township, Wabash County, Illinois, flowed 310 bbl. per day in a partly-open test.

These two discoveries have brought interest in Illinois development nearer the Wabash River and have precipitated much activity in the surrounding areas.

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Montana	.90-1.10	Kentucky	.90-1.10
Wyoming	.35-1.30	Indiana	.95
Colorado	.90- .98	Ohio	
New Mexico	.77-1.00	Lima	.90
Texas		Michigan	.70- .97
North Central	.71-1.03	Pennsylvania	
Panhandle	.67- .96	Bradford	2.00
West Texas	.53- .95	Southwest	1.65
Gulf Coast	.79-1.28	Eureka	1.59
Darst Creek	.96	Buckeye	1.55
East Texas	1.10	Corning	1.02
Talco	.55	Canada	2.10-2.17
Kansas	.60-1.10		
Oklahoma	.60-1.10		
Arkansas	.73		

DAILY AVERAGE CRUDE OIL PRODUCTION

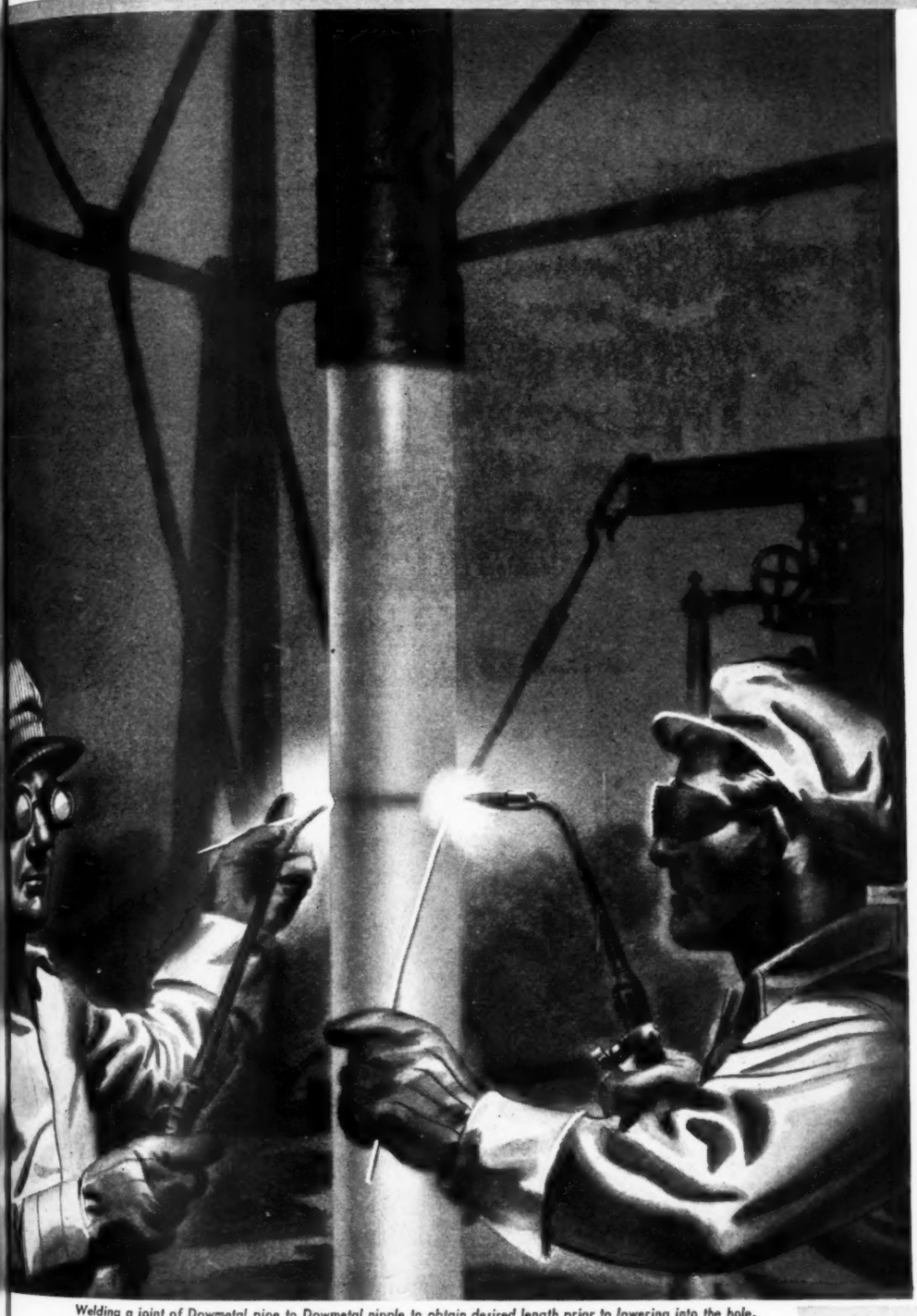
Data Supplied by A.P.I.

(Figures in bbl. of 42 gal. each)

	[1]B. of M. Calculated Requirements (July)	Week Ended July 29, 1939	Week Ended July 1, 1939	Week Ended July 30, 1938
Oklahoma	456,100	420,400	451,950	422,600
Kansas	160 300	179.400	169,100	154,000
Panhandle Texas	.....	68,700	69,000	72,350
North Texas	.....	93,900	86,200	78,600
West Central Texas	.....	32,400	32,500	29,200
West Texas	.....	242,150	218,900	218,700
East Central Texas	.....	97,600	92,300	100,400
East Texas	.....	373,000	372,800	439,600
Southwest Texas	.....	224,500	225,500	239,900
Coastal Texas	.....	227,450	214,950	213,400
TOTAL TEXAS	1.426.500	1,359 700	1,312,150	1,392,150
North Louisiana	.....	69,000	71,650	82,500
Coastal Louisiana	.....	206,600	199,600	186,950
TOTAL LA.	264.500	275.600	271,250	269,450
Arkansas	53,900	62,950	59,000	57,100
Illinois	187,400	276,300	245,200	142,400
Eastern (not incl. Illinois)	105,900	97,650	98,200	
Michigan	53,200	68,150	68,600	51,100
Wyoming	73,200	66,150	67,000	58,000
Montana	16,100	16,200	15,900	13,850
Colorado	4,800	3,850	4,050	3,700
New Mexico	116,100	109,150	106,600	101,350
TOTAL EAST OF CALIF.	2,918,000	2,935,500	2,869,000	2,665,700
California	595,200	603,600	594,000	650,700
TOTAL U. S.	3,513,200	3,539,100	3,463,000	3,316,400

[1]These are U. S. Bureau of Mines' calculations of the requirements of domestic crude oil based upon certain premises outlined in its detailed forecast for the month of July. As requirements may be supplied either from stocks, or from new production, contemplated withdrawals from crude oil inventories must be deducted from the Bureau's estimated requirements to determine the amount of new crude to be produced.

Dowmetal, a magnesium alloy developed and manufactured by The Dow Chemical Company, is industry's lightest structural metal. It is a full one-third lighter than aluminum. Engineers redesigning products to eliminate needless weight are constantly finding new and practical uses for Dowmetal. Some of the interesting applications of Dowmetal are its uses as airplane engine parts, radio antenna, bus bodies and chassis, typewriter and vacuum cleaner parts, portable tools, foundry flasks and many other products of equal importance.*



Welding a joint of Dowmetal pipe to Dowmetal nipple to obtain desired length prior to lowering into the hole.

DOWMETAL PIPE

A New Dowell Development

The chemical knowledge that pioneered the development of over 300 chemical products indispensable to industry also made possible the method of producing Dowmetal, thereby providing a domestic supply of this remarkable alloy. And it was Dowell who, through actual field work, perfected the use of Dowmetal in the oil string of producing wells.

Outstanding characteristics of Dowmetal are its *complete acid solubility, ease of welding, lightness* and *strength*. Dowmetal pipe in the oil string, placed opposite an upper pay zone, offers the efficiency of completion and production equaled only by drilling a new hole. The economical removal of the Dowmetal section with acid permits full exposure of the sand for production.

This new development is typical of the many advantages brought about through Dowell's association with The Dow Chemical Company. These two great organizations work hand in hand—Dow aiding in the original research and development—Dowell collaborating and performing the actual field service. This combination of forces is recognized as a major influence in the oil industry . . . since 1932 nearly $100,000,000 in additional recovery has been credited to Dowell methods and materials.

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All men who attend the Golden Gate International Exposition are cordially invited to visit the Dowell Exhibit in The Dow Chemical Company Booth.

Look to

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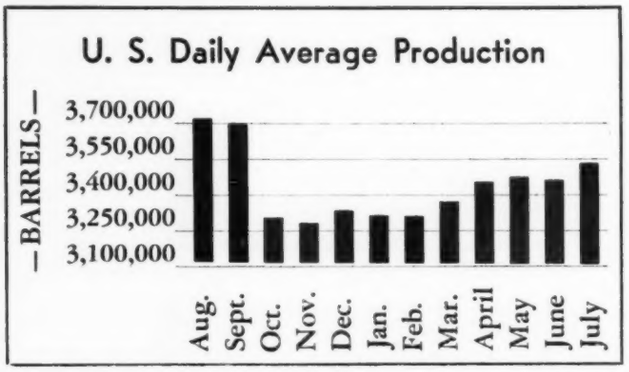
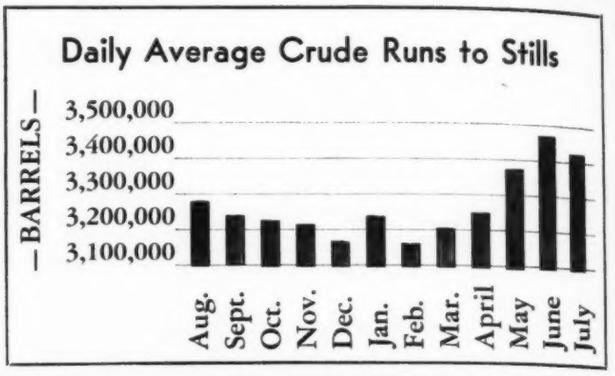
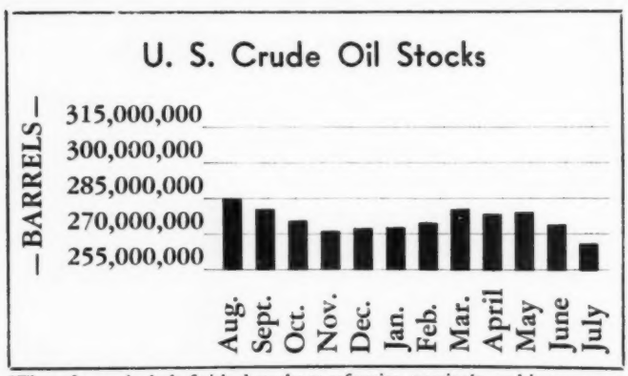
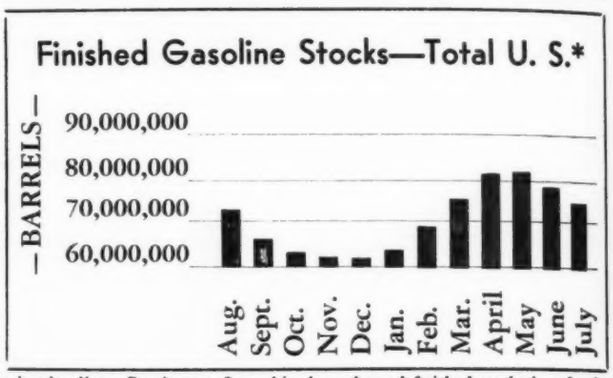
OIL AND GAS WELL CHEMICAL SERVICE

Petroleum Statistics and Field Activities









*These figures include finished stocks at refineries, terminals, and in transportation in pipe lines. Previous to June this chart showed finished stocks in refineries only. Above statistics by the American Petroleum Institute.

Summarized Operations in Active Fields for July, 1939

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	27	25	3	19	3500-3700	2	40	Rotary
Duval County	33	28	4	13	1554-2900	2	22	Rotary
Ector County	36	35	25	63	3675-4377	2 and 3	32-36	Rot.-Cab.
Panhandle	50	48	20	61	1700-3900	2	40	Rotary
Refugio County	20	14	3	10	4900-5900	2	38	Rotary
Nueces County	34	24	5	11	3922-5878	2 or 3	21-54	Rotary
Winkler County	9	9	3	9	2850-3450	2 and 3	30-38	Rot.-Cab.
K. M. A. Field	38	37	20	35	3730-3935	2	42-43	Rot.-Cab.
OKLAHOMA								
Oklahoma City	6	5	1	3	6450-6682	3	39	Rotary
Fitts Pool	9	7	3	8	1800-4488	2 or 3	38	Rotary
KANSAS								
Russell County	21	20	4	25	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	18	8	5	23	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	10	7	5	15	3290-3518	2	39-42	Rot.-Cab.
ILLINOIS								
Central Illinois	364	298	283	101	1425-4100	2	36-38	Rot.-Cab.
NEW MEXICO								
Lea County	35	34	10	50	3150-4030	3	30-34	Rot.-Cab.
CALIFORNIA								
Kettleman Hills	2	2	3	13	8300-8730	3 or 4	40	Rotary
Wilmington	21	21	15	21	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for July, 1939

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1938 (In Barrels)
	July	June	July	June	July	June	July	June	July	June	
Arkansas	23	10	23	9	28	29	18	20	34	32	18,211,617
California	91	94	82	80	88	93	90	75	187	169	249,918,001
Colorado	4	2	2	1	....	....	3	3	27	25	1,371,687
Illinois	364	384	298	310	....	....	283	280**	101	97	23,306,000
Indiana	29	22	22	9	....	....	9	10	61	56	965,900
Kansas	127	85	95	68	157	172	49	45	210	201	58,795,545
Kentucky	71	75	32	34	....	....	8	10	94	110	5,828,650
Louisiana	95	109	61	74	99	144	52	53	176	187	94,941,537
Michigan	144	130	92	75	130	174	21	20	133	143	19,140,966
Mississippi	2	1	0	0	....	....	3	3	3	4	Gas Prod.
Montana	21	18	15	13	....	....	5	4	50	51	4,858,458
New Mexico	53	55	41	49	....	....	15	17	131	135	39,902,263
New York	70*	36*	65*	33*	....	....	6	11	30	33	5,040,600
Ohio	93	76	69	52	....	....	49	40	149	135	3,292,100
Oklahoma	176	159	116	111	185	190	45	42	348	318	171,312,098
Pennsylvania	208	99*	190	91*	....	....	....	....	....	....	17,431,500
Texas	959	765	664	599	938	988	317	329	1094	1123	473,304,662
West Virginia	54	39	46	34	....	....	29	21	125	101	3,700,375
Wyoming	13	10	9	7	....	....	6	6	73	70	19,005,638
Total	2597	2169	1922	1649	1625	1790	1008	989	3026	2090	1,206,827,597

*Includes water-intake and pressure wells.
**Includes 214 rigs standing and 66 rigging-up.

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ARKANSAS: Magnolia; Arkansas City.
SALES OFFICES—Tulsa, Oklahoma; Dallas, Texas.

Major Pipe Line Activities

THE Utah Oil Refining Company, subsidiary of Standard Oil Company (Indiana), operating in Utah and Idaho, has started construction of the most extensive oil pipe line project of the year.

From the eastern terminus at Ft. Laramie, Wyoming, the 438-mile line will traverse nearly the entire southern part of Wyoming and extend into Utah to Salt Lake City, western terminus and delivery point of the line.

The entire line will be 8 in., except for 24 miles of 6 in. in the extreme western section from Uintah, Utah, south into Salt Lake City. In addition to the trunk line, a 31-mile lateral of 4-in. pipe will be laid from Opal to the main line at Granger, Wyoming; an 11-mile lateral of 4-in. pipe will be laid from Rock River, Wyoming, to a point on the main line just east of Medicine Bow, Wyoming.

Another more extensive lateral, proposed but not yet approved, may be built from Craig, Colorado, to intersect the main line at Wamsutter, Wyoming.

The line is strategically routed to provide an outlet for most of the fields in southern Wyoming and for new fields that may be developed along the line. The lateral to Opal will provide a link whereby oil from the LaBarge field, Sublette County, now piped to Opal for rail shipment through a 34-mile 4-in. line owned by Stanolind Pipe Line Company, may be delivered to the new main line. At Parco, Wyoming, a tie-in with an existing line will provide an outlet for crude oil produced in the Lost Soldier and Mahoney fields.

Fort Laramie will be an important junction in that a tie-in will be made to the Illinois Pipe Line Company's line from Lance Creek, 40 miles north. A connection will also be made to the Stanolind Pipe Line Company's 700-mile line from Teapot, Wyoming, to Freeman, Missouri. The latter line, said to be the world's longest gravity flow line, will provide an outlet for the new line to Eastern Seaboard and Gulf Coast ports if desired.

The new project, the first major pipe line to cross the Continental Divide, will have four major pumping stations on the main line proper, one major station at Opal, and a smaller field station at Rock River.

Contracts for the line construction have been awarded as follows: Williams Brothers Corporation, Jobs 1, 5, and 6: 50 miles, 71 miles, and 60 miles of 8-in., respectively; Truman Smith Pipe Line Construction Company, Jobs 2 and 4: 68 miles and 72 miles of 8-in., respectively; Osage Construction Company, Jobs 3 and 8: 73 miles of 8-in., and 31 miles of 4-in., respectively; and Bob Conyess, Job 7: 24 miles of 8-in. and 24 miles of 6-in. All pipe will be seamless manufactured by National Tube Company.

The major purpose of the line is to provide a pipe line source of crude oil for Utah Oil Refining Company's refinery at Salt Lake City, to which oil has previously been shipped via tank car.

Local labor will be employed on the project and the contractors hope that outside men seeking work will avoid needless expense coming to the job.

●

An important addition to the total mileage of gasoline pipe lines in the Mid-Continent and Gulf Coast areas will be made by Magnolia Pipe Line Company in a 192-mile line from East Texas to its refinery at Beaumont, Texas. The line will consist of 125 miles of 4-in., 59 miles of 5-in., and 8 miles of 6-in. The route will parallel that of the company's crude oil line from Kilgore to Beaumont. An initial pump station will be constructed at Kilgore and an intermediate station will be situated near Francis, Sabine County.

The line will transport natural gasoline and butane produced in five plants in the East Texas area.

●

Actual line construction has been completed on Socony-Vacuum Oil Company's 355-mile, 10-in. oil pipe line from East St. Louis, Illinois, to Lima, Ohio.

Construction of the eight pumping stations on the line is underway. The station at Patoka, Illinois, is virtually completed and ready for operation. The other seven stations are situated at Mitchell, Dietrich, and Martinsville, all in Illinois; at Staunton, Reno, Westfield, and at a site 10 miles from Muncie, all in Indiana.

This project has been constructed under the supervision of the Magnolia Pipe Line Company, subsidiary of Socony-Vacuum.

●

It is reported that an engineering survey for the proposed oil pipe line across the Isthmus of Tehuantepec, Mexico, is finally underway.

The survey is being made by engineers of Petroleon Mexicanos, the government petroleum administration, assisted by Germans and Japanese, it is stated.

Strength to the report that the line will actually be built is added by the fact that a considerable quantity of German-made pipe in excess of the amount needed for current field work is in storage at Tampico, large shipments of which have been received from time to time. The pipe is taken by Mexico in exchange for oil sold to Germany.

Mexico's interest in constructing a pipe-line outlet to the Pacific is largely to make it more attractive for Japan to divert its crude oil purchases from California.

●

Two short lines built by Humble Pipe Line Company will provide additional outlet for crude oil produced in the Tubb area, Crane County, and from Andrews and Ector counties, in Texas.

One line, 5½ miles of 4-in. pipe, will be built from the SE quarter of Section 3, Blk. 32, PSL survey, to the NE quarter of Section 9, Blk. B-27, PSL survey, tying-in to the company's line north of Judkins.

The other line will be an 8-in. loop of an existing 10-mile section of 8-in. between Judkins and Crane.

●

The Texas-New Mexico Pipe Line Company has announced plans calling for the laying of 21 miles of 14-in. and 20 miles of 10¾-in. pipe line in New Mexico. The lines will take oil from the Eunice, Monument, and Vacuum fields and deliver to the company's station at Jal, New Mexico.

●

The Latex Construction Company, Houston, Texas, has completed the laying of 25½ miles of line for the Louden Pipe Line Company. The line extends from the St. Elmo field, Illinois, to Pana, Illinois, where crude oil is delivered to the Pana Refining Company. The main line, 22 miles in length, is of 5-in. pipe, and there are 3½ miles of 4-in. gathering lines.

●

A total of 110 miles of gathering and residue lines will be laid in the Wasson and Bennett fields, Texas, to serve a natural gasoline plant being constructed in the Wasson field by the Shell Oil Company. The size of the pipe varies from 3 in. to 22 in. The contractor for the work is the Latex Construction Company, Houston, Texas.

P 111.33
P 425.2

THE Petroleum Engineer

AUGUST, 1939

Heavy-Duty Drilling Equipment Required in Magnolia Field, Arkansas

Orderly development has resulted in 45 producers on 40-acre spacing—ultimate number of wells may be 108 by next April

By H. LEE FLOOD
Associate Editor

THE Magnolia field in southwestern Arkansas during its short life of 16 months has had a most interesting history that began with the drilling of three dry holes in rapid succession following the completion of the discovery well and developing to its present position of being one of the most active drilling areas in the Tri-State region. Because of the interest in the drilling activity of the field it will be that phase of the development that will be discussed.

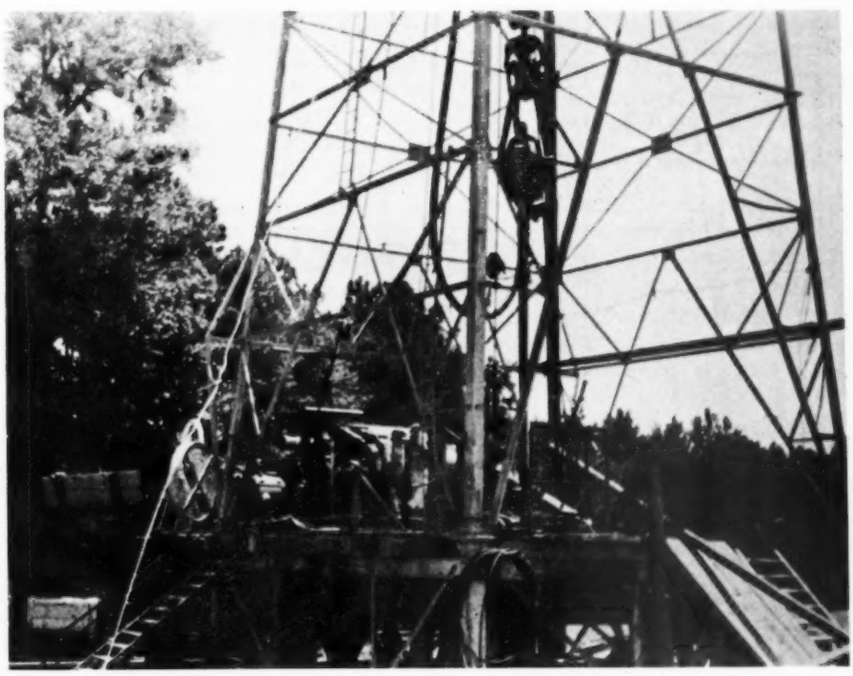
Situated in Columbia County, the field derives its name from the town of Magnolia, 5 miles west. Nearest city of importance is El Dorado, approximately 30 miles east of the field.

Drilling History of Magnolia Field

Following completion of the discovery well, No. 1 Barnett of Kerr-Lynn and Company in C SE SW NE Sec. 14-17-20, no other producing wells were obtained until September, 1938. During the six-month interval between the completions of the first and second producers, however, three dry holes were drilled, one to the west and two to the east of the discovery well.

At the time the discovery well was completed, it was believed rightly that the axis of the fold was in an east-west line but it was thought that the well was near the center of the oil-bearing section instead of on the north flank, as has been determined in the later development. The "structure" had been mapped by seismograph and it is interesting to note that the tendency to map the major axis of the structure slightly north of its actual position has seemed to be more or less characteristic of other pools in southern Arkansas outlined by seismograph and later developed.

After the completion of the third dry hole, prospects for a pool were not very encouraging. Moving to the south of the discovery, however, for an additional test proved a fortunate choice in that the second producer was obtained and enough additional geological data were gathered to provide a correlation of the logs of the two pro-



Drilling at the rate of 1 ft. per minute in the Magnolia field, Arkansas

ducing wells that indicated definitely that the axis of the fold was farther south.

An idea of the stimulus to drilling that was provided by the successful completion of the second producing well may be gained from the following schedule of completions:

	Producers	*Dry holes*	*Total completions, cumulative*
1938—			
March	1	0	1
April-August	0	3	4
September	1	0	5
November	2	0	7
December	6	0	13
1939—			
January	2	0	15
February	3	0	18
March	3	0	21
April	3	0	24
May	8	0	32
June	6	0	38
July	10	0	48
Totals	45	3	

Drilling Equipment

At the present time there are 17 drilling rigs available for use in the Magnolia field. This total number is divided between eight contractors and one oil company. The maximum number of rigs owned by a single operator is three. Three contractors have three rigs each; two contractors have two rigs each, and the rest own one rig each.

All drilling is done by heavy-duty, steam-powered rotary equipment. The largest drawworks in active service in the field is also the largest unit manufactured by one of the leading supply companies. It is a four-speed, roller-bearing-equipped drawworks having a 9-in. drum shaft, an 8½-in. line shaft, an 8½-in. jack shaft, and a 54-in. diameter brake rim. Developed and placed on the market only this Spring, the machine in the Magnolia field is the first one purchased by a drilling contractor. The only other unit of this model built to date is in service in the deep drilling of southern Louisiana.

The heavy equipment is justified in the Magnolia field because of the depth and the speed with which the wells may be drilled. Three heavy-duty steam boilers are standard equipment for providing power for drilling operations. An important part of successful drilling in the field and in avoiding stuck drill pipe and twist-offs is the maintenance of 1000- to 1200-lb. pressure by the mud pumps.

Drilling operators in the field are fortunate in having a good supply of neutral water that may be used untreated in the boilers. Water is supplied to the majority of drilling rigs by one of the leading drilling contractors in the field who owns and maintains a well and reservoir.

Casing Program

The presence of troublesome anhydrite in the upper formations and the necessity of protecting shallow fresh water-bearing strata makes the use of an intermediate casing string mandatory in the Magnolia field.

The Arkansas Oil and Gas Commission in its Order No. 8-39 dated March 31, 1939, prescribed certain requirements that dictate largely the casing program to be followed. A portion of this order is quoted as follows:

"Rule IV. Casing Program. — The casing program of all wells hereafter drilled to the Lime Pool in the Magnolia field shall be as follows, unless otherwise ordered.

"(a) A minimum of 100 ft. of surface casing shall be set and cemented with not less than 50 sacks of cement. * * *

"(b) A second string of casing shall be set at a minimum depth of 2200 feet and shall be cemented with sufficient cement to fill the annular space back of the casing up into the surface casing, using not less than five hundred (500) sacks of cement. * * * Said second string of casing shall be new casing or reconditioned casing that has been tested to thirteen hundred (1300) pounds per square inch pressure. * * *

"(c) The producing string of casing shall consist of new casing, mill-tested to at least two thousand (2000) pounds per square inch pressure, which shall be set below the gas-oil contact of, or set completely through and perforated below the gas-oil contact of, the oil-saturated formation. * * *

In conforming with the above general regulations, operators in the Magnolia field are setting 110 to 150 ft. of 13⅜-in. to 16-in. casing as a surface string; 2200 to 3200 ft. of 9⅝-in. or 10¾-in. casing as a second string, and approximately 7600 ft. of 5½-in. to 7-in. casing as an oil string. The longer (3200 ft.) second strings are being set by some operators to case-off the troublesome anhydrite strata encountered at about this depth. Tubing strings are 2 in. or 2½ in., either hung in the well or set with a packer.

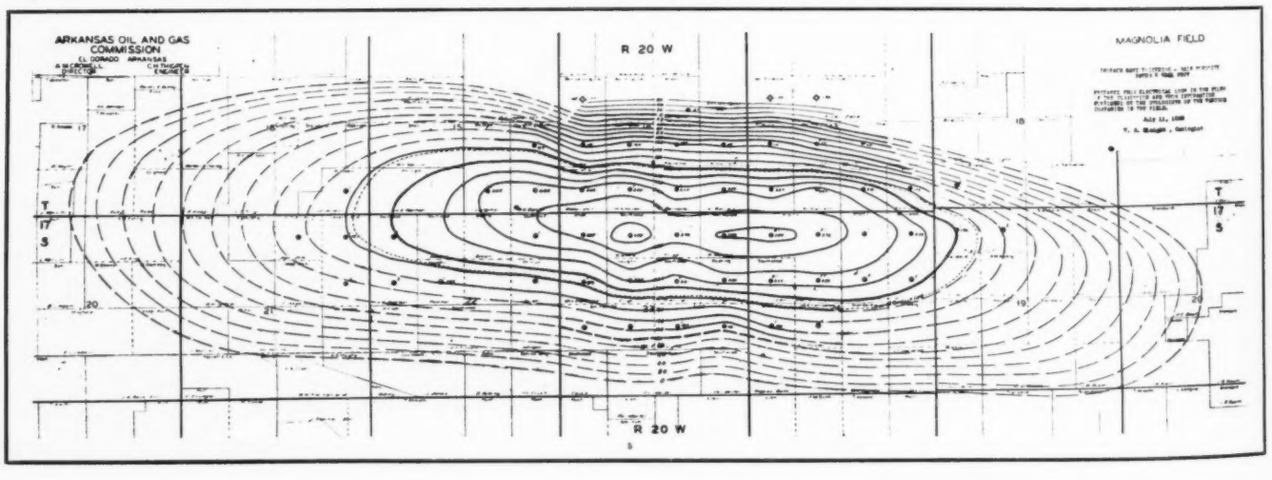
In setting the surface string, the average number of sacks of cement used is nearer 200 than the minimum of 50 specified by the Commission The second casing string is cemented with 900 to 1100 sacks and the oil string may require 1500 to 2000 sacks to obtain the desired results.

Drilling Speed

Subsurface formations in Magnolia are classed as easy "digging" by drillers in the field so that despite precautions that must be taken at certain depths to avoid sticking the drill pipe, a well can be drilled and completed in a relatively short time.

An analysis of 26 of the 45 present producing wells discloses that the average drilling time per well is approximately 40 days, or about 190 ft. of hole per day. This average includes the age drilling time per well is approxitime on one well for which 108 days were required to obtain a completion. Another well required 82 days to complete. In both of these wells several twist-offs and fishing jobs were experienced.

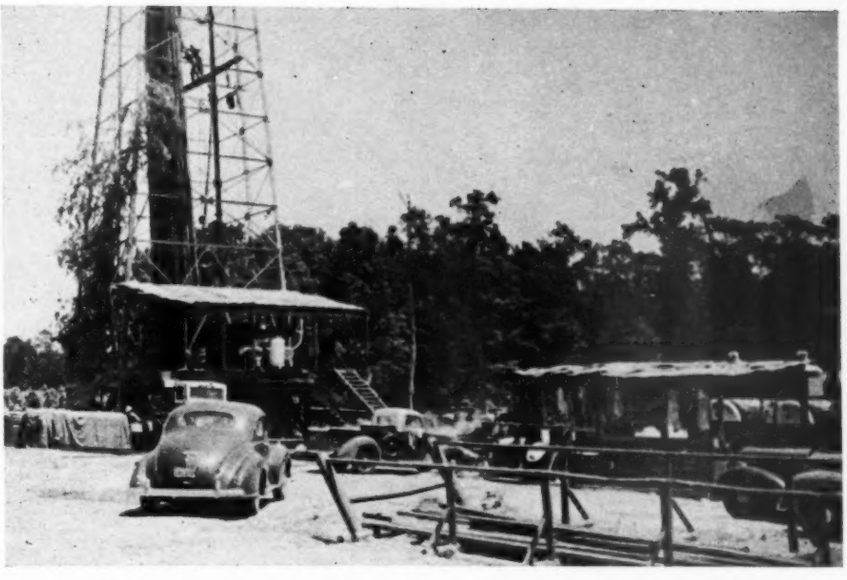
Fig. 1. Contour map showing thickness of main section of Reynolds oölite—Magnolia field, Colombia County, Arkansas



One drilling contractor has established a reputation for drilling faster and obtaining a completion in fewer days than any other operator in the field. This contractor has two rigs running in the field and the usual time required by his men to complete a well is 23 or 24 days. In order to analyze the reasons for the ability to drill consistently faster, the subject was discussed with the contractor and with several other operators in the field.

According to the contractor himself he is probably violating all the rules for conservative drilling but he is getting results at what he believes is a lower cost and this is the yardstick that counts with him. The general plan of drilling is to carry a maximum amount of weight on the bit and to use clear water, containing only what mud is drilled-up, as a drilling fluid during the greater part of the upper drilling. An important point that is stressed, however, is that the circulating pumps must deliver not less than 1100 to 1200-lb. pressure to insure the cuttings, particularly those of the anhydrite formations, being removed from the hole to prevent their swelling and sticking the drill pipe, causing a twist-off.

Carrying maximum weight on the bit brings up the question as to whether a straight hole is being obtained. Apparently the deviation from vertical in the holes drilled by this contractor is within the one degree usually permitted in a closely-controlled well. This ability to drill straight at high speed and with all the weight on the bit probably depends largely upon the 120-ft. drill collar and four stabilizers that are used just above the bit.



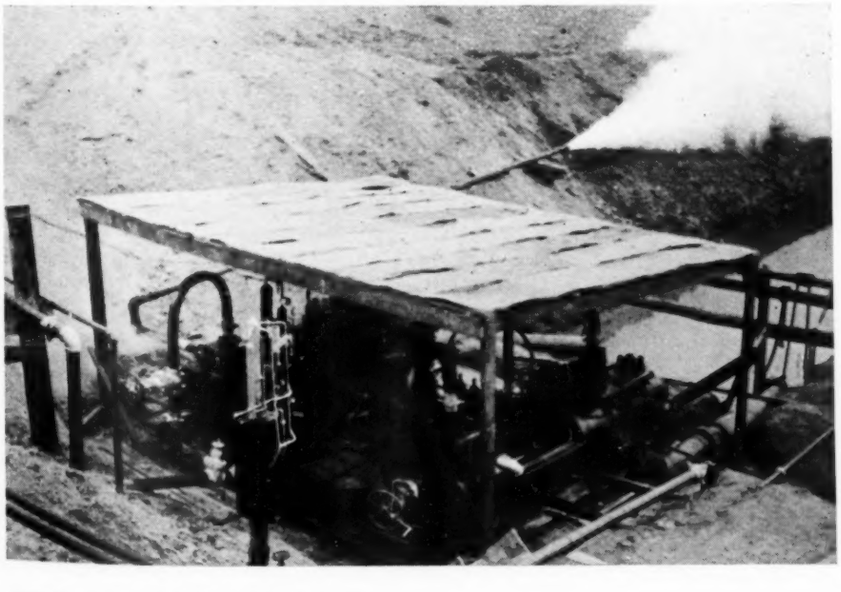
Running casing and standing-by to cement in a well in Magnolia field

One of the outstanding points that was mentioned oftenest in discussions of this contractor's ability to "chalk up" faster drilling rates was that the contractor's drillers have all been with him for 15 to 20 years; they understand their business, they work well together, and, most important of all, they have a feeling of pride in their work and in their organization. This factor is one of the most valuable assets any organization can have, even though it is one that is difficult to evaluate tangibly, and it may well be a decisive contributing element in the faster drilling speed being obtained. More to the point, this contractor has drilled more wells in the field than any other and, consequently, the drillers "know" the field and are better able to proceed rapidly.

Probable Number of Wells to Be Drilled

Based on the thickness contours of Fig. 1 (a large part of which is estimated and subject to change as additional wells are drilled) and adhering to 40-acre spacing, 75 wells may be drilled to penetrate 100 ft. or more of the main porosity section of the Reynolds cölite. Excluding the 42 wells now drilled within this area but including wells now drilling, there are 33 "favorable" locations still open for drilling. In the "fringe" area outside the 100-ft. contour and inside the zero-ft. contour, 51 locations may be made on a 40-acre spacing. Deducting the 21 locations within the zero- and 20-ft. contours, it appears reasonable that 30 of these fringe locations may be drilled.

Estimated in this manner, a total of 63 locations remain to be drilled. If an average of ten wells is completed during each of the good-weather months—August, September, and October; eight wells are drilled during each of November and December, and five wells are drilled each month starting in January, 1940, the field should be drilled-up by next April.



Heavy-duty mud pumps provide 1000- to 1200-lb. pressure in drilling operations

TRINITY INFERNO

MAKES POSSIBLE A COMPLETE SHUT-OFF

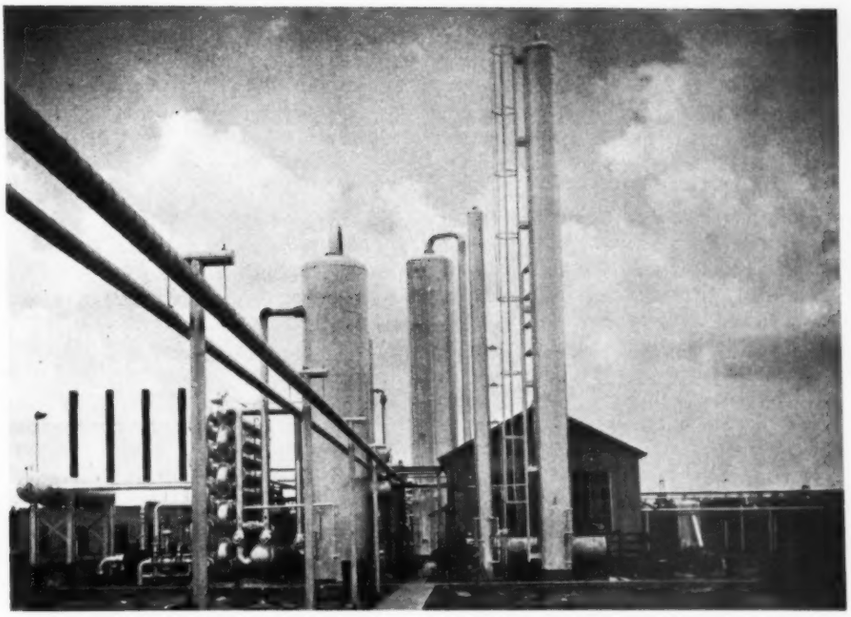
in an area where most other squeeze jobs failed!

They had tried squeezing wells before in the old El Dorado East field, but without much success. Then the Placid Oil Company squeezed their Gregory No. 1. First, 100 bags of Trinity Inferno, 15.6-lb. slurry, was pumped in at a starting pressure of 500 lbs. Then 311 more bags averaging 16.65 lbs. to the gallon, with pressure increasing up to 3,000 lbs.

"I am very glad to say that we were successful with the squeeze job," writes Superintendent W. E. Hill. "The Shut-Off was 100 per cent."

That's just one of the many jobs where Trinity Inferno slurry has proved that it remains easily pumpable, at a low water-cement ratio, in spite of high temperature. Trinity Inferno is also highly resistant to sulphates and contamination.

View of gasoline and butane stabilizers, absorber, still, heat exchangers, and pump house



By

FRANK H. LOVE

Managing Editor

New Plant Equipped to Manufacture Natural Gasoline and Butane

Unit in Fairbanks field, Harris County, Texas, has capacity of 40,000,000 cu. ft. per day, taking gas from about 225 wells

TO provide for processing casing-head gas from a group of approximately 225 wells to obtain natural gasoline and butane the Warren Petroleum Corporation has recently placed in operation an absorption-type gasoline plant in the Fairbanks field, Harris County, Texas. The capacity of the plant is 40,000,000 cu. ft. of gas per day.

Gas is taken from the field separators at a pressure of 40 lb. and transported to the plant through a network of gathering lines varying in size from 3 in. to 16 in. The total length of the gathering system is approximately 20 miles. The two intake scrubbers, which are 7 ft. in diameter by 10 ft. high, receive the gas through a 16-in. line and discharge to the absorbers at a pressure of 35 lb. The absorbers are 16-tray units 8 ft. in diameter by 48 ft. 6 in. high. From the absorbers the residue gas enters a 7-ft. by 10-ft. scrubber, after which it is discharged to the residue gas manifold.

As there is at present no commercial outlet for the residue gas, numerous uses are made of it in the plant. The gas is utilized as fuel for the boilers and for the recompressor engine. Energy of the gas is utilized to drive turbines connected to the rich and lean oil pumps; for flowing the water wells, and for lifting water over the cooling tower.

Rich Oil Cycle. From the absorbers the rich oil having the gasoline content entrained is pumped through eighteen 12-in. heat exchangers, and 20-in. preheaters to the still. In this service a centrifugal pump is employed having a capacity of 600 gal. per min. and driven by a 65-hp. turbine. The oil is discharged from the heat exchangers at a temperature of 360°F. and from the preheater at a temperature of 380°F. From the still, which is 6 ft. in diameter by 30 ft., the oil is returned through the heat exchangers, leaving at a temperature of about 180°F., to enter the cooling coils in the base of the cooling tower. The coils consist of 15 sections each having 477 sq. ft. of surface. From here discharge is into the absorbers at a temperature of 87-90°F. for the beginning of a new cycle.

Vapor Cycle. From the still, operated at a pressure of 47 lb., vapors are discharged to the dephlegmator. The top temperature on the latter is maintained at 240°F. to obtain an end point on the gasoline of 315°F. Upon leaving the dephlegmator the vapors pass through three primary condensers situated in the base of the cooling tower. Here the heavier ends are condensed and are collected in a 4-ft. by 8-ft. accumulator at a temperature of approximately 130°F. Reflux is returned to the dephlegmator and the lighter ends are sent to two final condensers, thence to a 6-ft. by 20-ft. accumulator at a temperature of about 80°F. Vent gas from this accumulator enters a 110-hp. recompressor having a 9-in. by 20-in. compressor cylinder. After being compressed to 250 lb. it is condensed, a part of the condensate being used in the manufacture of natural gasoline and a part in the manufacture of butane. From the 6 by 20 accumulator, or raw make tank, the lighter fractions are discharged to the stabilizer. This unit is 3 ft. in diameter and 49 ft. 6 in. high and contains 30 trays. It is operated at a pressure of 150 lb. and a temperature of 283°F. is maintained to produce a gasoline of 14-lb. Reid vapor pressure. Vapors leave the top of the column, pass through cooling coils situated in the cooling tower, the condensate entering the stabilizer reflux tank. It is picked up there and pumped to the top of the stabilizing column. The finished gasoline is stored in four 10-ft. by 40-ft. horizontal tanks having a capacity of 24,000 gal. each. A loading rack two miles distant is con-

nected to the storage tanks by a 3-in. line.

Butane Manufacture. An important phase of the Fairbanks plant's operation is the manufacture of butane. For this purpose special equipment has been installed. Feed to the butane fractionating column is obtained from the gasoline stabilizer accumulator or reflux tank. Vapors from the top of the butane fractionating column pass to a condenser, then through a 2½-ft. by 6-ft. accumulator, the reflux being returned to the fractionating column. The finished butane is pumped to a 10-ft. by 40-ft., 24,000-gal. capacity storage tank. The butane fractionating column is a 22-tray, 16-in. by 34-ft. unit, operating at a pressure of 300 lb. and a temperature of 217°F. The finished butane has an initial boiling point of plus 12 and an end point of 31°F.

Steam Plant. A closed steam system is employed, the efficiency of which is indicated by the fact that but 5 to 8 percent makeup water is required. Steam is generated in four 125-hp. oilfield-type boilers operating at 250-lb. pressure. Processing steam, as well as that from all steam-powered units, is trapped and returned to a condensate tank situated immediately outside the boiler house and is utilized as feedwater to the boilers.

Water Supply. Two water wells drilled to a total depth of 150 ft. supply water for the plant. Tubing is set in the wells at a depth of 120 ft. and flow is by gas-lift. After the wells have been shut-down a greater pressure than that required to flow them is sometimes needed to "kick" them off. For this purpose a 1½-in. line extends from the butane accumulator tank to the wells.

Cooling Tower. The 13-bay cooling tower has capacity for cooling 2600 gal. of water per min. An interesting arrangement has been made to boost water over the tower by means of gas-lift. To accomplish this a 24-in. casing was sent in the base of the tower to a depth of 60 ft. Inside the 24-in. casing a 12-in. pipe was placed on bottom. A 3-in. gas-injection line extends on the outside to the bottom of the 12-in. and water is lifted to a separator on top of the tower through the 12-in. pipe. Extending from the separator are two 8-in. lines for distributing water over the top louver of the tower. Because in cold weather it will not be necessary to use the entire cooling tower, a 6-in. line extends from the tank to the lower louver. When desired the 8-in. distribution lines can be closed and water circulated only from the lower level of the tower. A 6-in. line leads from near the top of the water tank to serve as a vent line for the gas used in the lifting process.

Pumps. The following pumps are used in the operation of the plant:

(1) Two 6-in. by 5-in. by 12-in. stabilizer feed pumps.
(2) One 8-in. by 5-in. by 12-in. stabilizer reflux pump.
(3) Dephlegmator reflux pump, 8-in. by 5-in. by 12-in.
(4) Standby pump for dephlegmator reflux, 10 in. by 6 in. by 12 in.
(5) Two butane pumps, for feed and reflux, 6 in. by 3 in. by 8 in.
(6) Oil-charging pump, 4¼ in. by 2¾ in. by 4 in.
(7) Two low-stage condensate pumps, 6½ in. by 4⅛ in. by 8 in.
(8) Gasoline-loading pump, 10 in. by 6 in. by 12 in.
(9) Butane-loading pump, 6 in. by 3 in. by 8 in.

Gasoline Analysis. The type of gasoline being obtained is indicated by the following data:

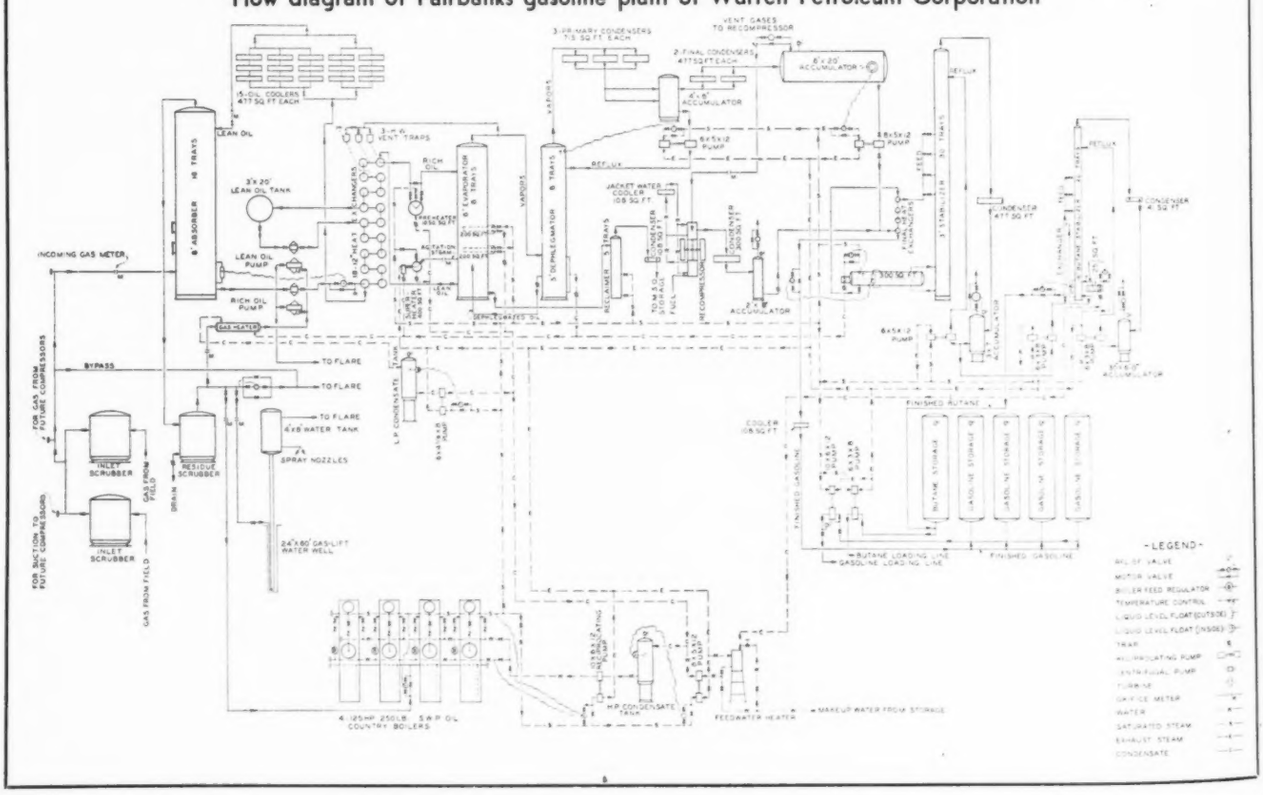
Physical Properties:

Color	30 plus
Doctor test	sweet
Corrosion	negative
14 lb. vapor pressure	
Gravity	79.5
Octane number	78

Distillation Analysis:

Initial boiling point	86°F.
14 cc. over at 100 deg.	
58 cc. over at 140 deg.	
88 cc. over at 212 deg.	
End point	317°F.
Loss	1 percent
Residue	1 percent
Recovery	98 percent

Flow diagram of Fairbanks gasoline plant of Warren Petroleum Corporation



Fundamental Considerations of Recycling in Condensate Production

Careful consideration of all factors involved should safeguard against uneconomical installations

By
EMBY KAYE
Tide Water-Seaboard Oil Companies

ONE of the interesting subjects under discussion in production circles in the Gulf Coast and East Texas areas at this time is that of recycling, or pressure maintenance, as a means of producing distillate or condensate from gas-distillate pools. In the last few years, a great many such pools have been discovered; in 1938 alone, out of 111 new pools discovered in Texas, 27 were of this type.

From the earlier publicity attending recycling it appeared that this production practice was an exact science, and that every distillate well or pool could be produced by its use. This is anything but true. Although there are some eight or nine commercial plants in operation, there is very little history of the performance in a reservoir where recycling is practiced. Large scale operations that should contribute substantially to this history may be said to have started only this year. One cannot be dogmatic concerning the behavior of gas returned to a reservoir, or the extent and the effect of diffusion; however, many factors in recycling can be carefully evaluated. Relatively few of the many distillate pools discovered present attractive exploitation prospects, due to limited distillate content per acre, total reserve, or to the character of the formation.

When a reservoir has the requisites for a distillate project, careful planning for its development is necessary if maximum returns are to be obtained. A plant should be large enough to be economic on the one hand, but on the other, it should not be so large that the gas is "turned over" in too short a time. Input wells for the return of dry gas to the formation should be situated to give the longest life to the wet gas or output wells, and permit the maximum production of gas for processing. The ideal well pattern is one wherein the gas is taken from the flanks and returned to the gas cap.

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is a graduate of Harvard University —His affiliation with the petroleum industry began in March, 1919, with the Skelly Oil Company, Tulsa, Oklahoma—He became superintendent of the Natural Gasoline Department and later vice-president in charge of refining—This position he retained until April, 1938—Is now associated with the Tide Water and Seaboard in their joint recycling projects.

This is particularly desirable when the boundaries of the field have not been described.

Although in theory the dry gas is designed to purge the wet gas by driving it toward the producing gas wells, some amount of diffusion will occur and allowance must be made therefor. The farther the input wells are from the output wells, the longer will undiluted gas be produced. It has been calculated by some engineers that under ideal conditions approximately 110 percent of the gas in a reservoir will have to be turned over to process 100 percent of the wet gas. Where less than ideal conditions obtain, the gas may have to be processed considerably more than that, depending upon the extent of the diffusion. Foran and Dixon[1] have presented a discussion on this subject that is helpful and instructive.

Objective of Recycling

There is only one objective in a recycling plant. It is to obtain the maximum distillate recovery aboveground by preventing condensation of distillate in the reservoir. It is to this end, of course, that the denuded gas from the recovery plant is returned to the formation to maintain as nearly as possible the virgin pressure on the formation. The condensate in the gas is just above the dew point and a drop in pressure would condense portions of the vapors in the formation. Pressure drop is therefore avoided until the gas is brought to the surface, and preferably until it is introduced into the processing unit, so that the effect of expansion may be utilized.

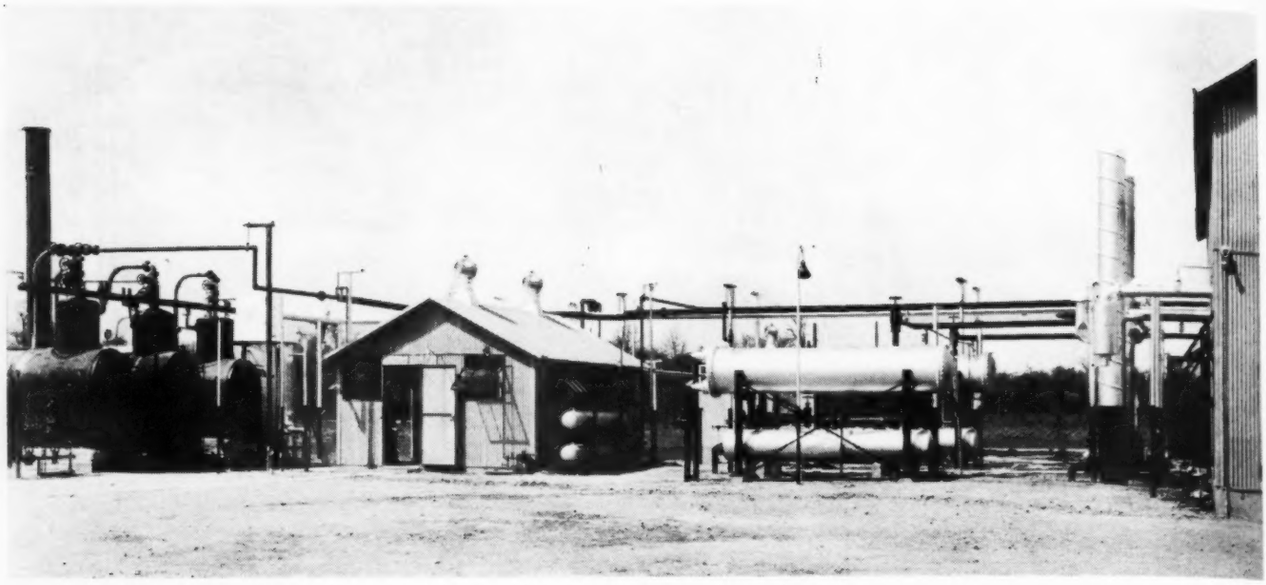
Requisites for Recycling

A satisfactory gasoline or distillate content of from 18 to 20 bbl. per million cu. ft., a reserve large enough to assure a minimum of seven to ten years for turnover of gas, and high permeability are the fundamental requirements for a recycling project. A thick gas section reduces the cost of plant and lines per acre of reserve, as is indicated later.

Recovery Processes

Probably all processes depend upon the utilization of the phenomenon of retrograde condensation as a step in the extraction process. In the low-temperature plant, additional normal condensation by employing subnormal temperatures increases the recovery, and in the absorption plant additional recovery may be expected although most of the distillate is recovered by retrograde condensation and cooling. Much de-

[1] "Condensate Wells—Completion and Recycling Operations" by E. V. Foran and P. C. Dixon. Paper presented at Spring Meeting, Southwestern District, A.P.I. Division of Production, San Antonio, Texas, March 17, 1939.



Boilers, auxiliary pump room, engine jacket coolers, and ammonia condensers, Tide Water-Seaboard recycling plant, Cayuga, Texas

pends on the composition of the gas, as to whether and to what extent additional external cooling or absorption is justified. Consideration also must be given to the kind of product for which there is a market before the economics of increased extraction may be determined.

Present plants, with some exceptions, are operated more or less along similar lines. In the so-called low-temperature plants, to utilize the refrigeration available by expansion, the gas is brought to the plant with a minimum of pressure drop. The gas is cooled by water to 80-90° F., then by gas-to-gas heat exchangers to 50-68° F. When lower temperatures are desired, dehydration by ammonia or by expansion where possible may be employed to obtain a temperature of 5-10° F. before the gas is expanded into the separator-accumulator, wherein the temperature is further reduced to 5-0° F. The dry gas after use as an exchange medium is picked up by the compressors at about 50-60° F. and returned by input wells to the formation.

The cooling of the gas to lower temperatures, quite apart from extraction efficiency, results in (1) increased free gas capacity of compressor, (2) increased capacity due to supercompressibility at low temperatures, (3) lower back pressure in return lines and casing due to lower temperature and reduced viscosity of the gas. These factors when taken into account effect a reduction in the cost of a plant of given capacity.

To prevent the formation of gas hydrates, a hygroscopic material—calcium chloride, glycol, etc.—is introduced into the gas stream after it leaves the gas cooler, and is withdrawn from the bottom of the separator-accumulator for reconcentration and use. Water may first be drawn-off after it leaves the gas cooler. Without dehydration, the gas when cooled to a temperature of less than 60-70°F. will result in freezing of hydrates and interruption of operation. At higher pressures hydrates form at even higher temperatures. In the Tide Water-Associated-Seaboard Oil Company plant at Cayuga, Texas, calcium chloride is used successfully and with a minimum of care and expense. Dehydration is apparently justified whether extremely low temperatures are sought or not. Usually additional refrigeration by expansion of the gas can be utilized if these hydrates can be eliminated.

In some plants no cooling is attempted below 68-70°F., which is above the hydrate freezing temperature for those plants. The owners did not go the full extent of the operation described above, for one reason or another. Some operators installed the barest essentials to enable them to obtain an income and deferred the steps to obtain efficient extraction until their revenues justified the additional expense. Others wanted to extract the heavier ends only, to avoid the expense of stabilization of the condensate. Sooner or later, plants of this type having a substantial reserve of gas available will undoubtedly add those "details" that make for greater recovery, as once processed it is likely that a considerable part of the gas will not pass through the plant again. The final cooling step by an outside refrigerant may not be necessary if enough refrigeration is available by the Joule-Thompson effect.

Under some circumstances, the gas can be cooled to a temperature greater than the hydrate freezing point, passed through an oil absorber, and the hydrocarbons distilled from the oil absorbent at low pressure in the conventional manner. So far as is known today, however, the pressure in the absorber must be reduced to the retrograde condensation pressure, so that in effect the absorption feature is a minor addition to the moderately low-temperature operation described, in which 75-85 percent of the recoverable content is "knocked out." One such plant is operating at the present time at pressures that have varied from 1000 to 1200 lb. per sq. in. Several additional plants are reported to be under design for early construction.

Cost of Gas

Recycling plants have revived a problem involving the price to be paid for gas that was also present when the first casinghead, now natural gasoline plants, were built in the Mid-Continent area several decades ago. For a long time there was no yardstick on the basis of which gas could be purchased by a plant from a producing property.

Today and for a great many years, however, the schedule of values established by the Natural Gasoline Association of America is considered the standard for gas values. In that schedule the price to be paid varies in relation to both the market value of gasoline and the gasoline content of the gas. This schedule follows in part:

Sales price of gasoline in cents per gal.	Gasoline content in gal. per M cu. ft. of gas										
	.50 to .75	.75 to 1.00	1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 and above
1.5 to 2.0	7.5	8.75	10.0	11.25	12.5	13.75	15.00	16.25	17.5	18.75	20.0
2.0 to 2.5	8.75	10.0	11.25	12.5	13.75	15.0	16.25	17.5	18.75	20.0	21.25
2.5 to 3.0	10.0	11.25	12.5	13.75	15.0	16.25	17.5	18.75	20.0	21.25	22.5
3.0 to 3.5	11.25	12.5	13.75	15.0	16.25	17.5	18.75	20.0	21.25	22.5	23.75
3.5 to 4.0	12.5	13.75	15.0	16.25	17.5	18.75	20.0	21.25	22.5	23.75	25.0

In recycling plant practice there is no uniform schedule. This arises from the fact that the genesis of the business is of recent date, and it was "every man for himself" at the beginning. As a result, schedules differ in some respects as to what is paid to the producer. The question naturally arises why, if at all, a different value should be placed upon wet gas when processed in a recycling plant as against that used by the natural gasoline industry.

From the standpoint of the producer of gas, higher prices should be paid for gas than is paid by the natural gasoline manufacturer, because the producer is not selling a by-product but his only product, and has to amortize his wells from gas revenue alone.

Frequently the owner bought his acreage on expectations of oil, not gas, and paid what now appears to be excessive prices therefor. These considerations, however, have no proper place in fixing a fair value upon the gas. To justify the various risks involved in constructing a processing plant, the plant operator must obtain the right to process the gas on a basis that permits reasonably rapid return of his investment. This return must be sufficiently inviting or the plant will not be built.

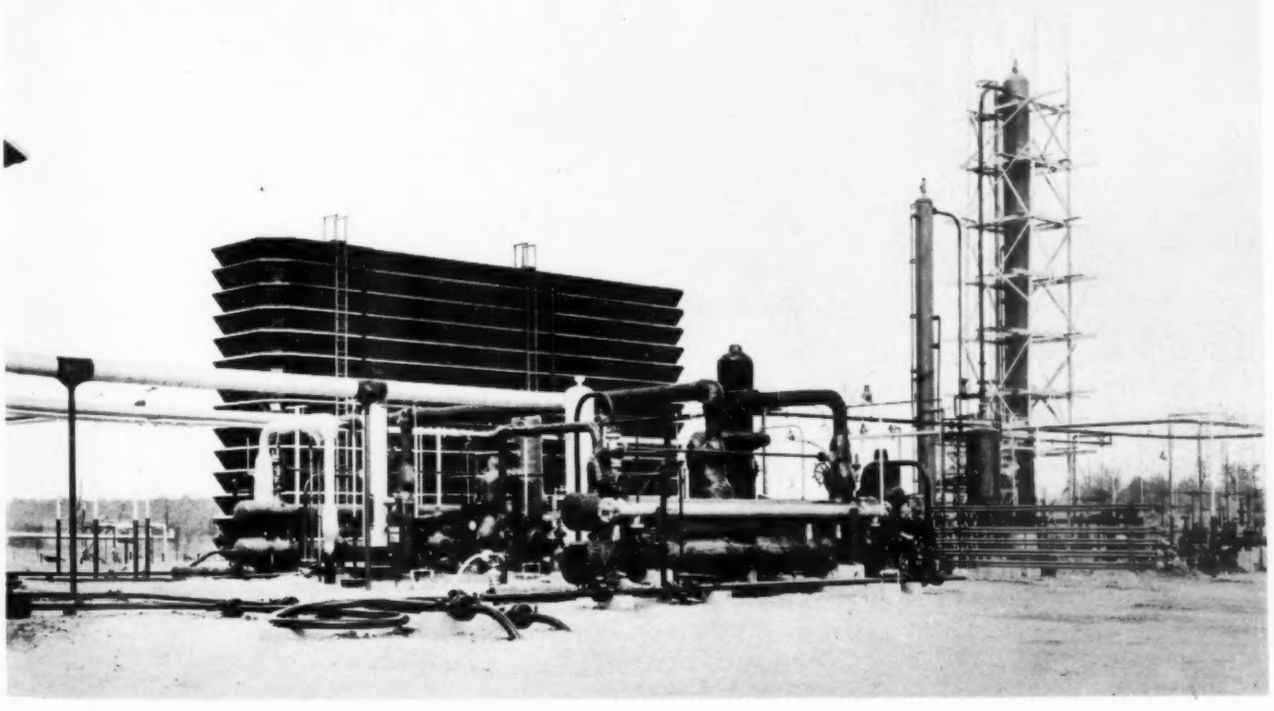
Natural Gasoline Plant vs. Recycling

The prospective operator of a recycling plant does not have any history to indicate the life of the project, because large scale operations date their beginning only this year. The natural gasoline operator has a long history of operations behind him; literally thousands of records to use in a study of reserve declines and depletion rates. In a great many instances, plants have been operated when the revenue from crude oil diminished almost to the vanishing point; in others, plant life was extended by repressuring operations, the application of vacuum, etc. Plants are still operating at a profit today after a life of 25 years.

On the other hand, the recycling operator does not know how long he will be able to process gas before the gas returned to the formation will show up in the wells delivering gas to the plant. Obviously, the larger the acreage and the greater the distance of "input" wells from "output" wells, the longer the plant may be expected to operate on virgin gas. Sooner or later, however, the diffusion of dry gas into the wet gas area, due to pressure differentials developed by the operation and the natural migration of the input gas toward low-pressure areas, will result in a diminution of liquid recovery. The operator is almost completely in the dark as to how soon or to what extent this will occur, and as a result does not know how much of the known reserves he will ultimately process before the dilution of the gas makes the operation entirely unprofitable.

In a recycling plant as in a natural gasoline plant, it costs very little more to process a gas containing two gal. of gasoline or distillate than it costs to process a gas containing three-fourths gal. Stabilization equipment, storage, fuel, and power are of course increased per unit of gas processed when the gas is richer. This cost is so slight

Recycling plant of Tide Water-Seaboard Oil Companies at Cayuga, Texas. This plant employs the Vaughan Process



that it may be said that there is virtually no additional processing cost for the additional gallon and a quarter recovered, or in any event that it is exceedingly low in relation to the cost of extracting the first three-fourths gal. Obviously, this results in a greater financial return from the plant.

Sand thickness, acreage, and reservoir pressure determine the gas reserve and hence the possible ultimate recovery. In addition, they determine the probable life of the plant. A longer prospective life of a plant will result in the operator being satisfied by a somewhat smaller annual return.

Where the acreage is compact, the blocks in relatively large units, and the sand thick, a smaller investment in lines is required for the ultimate recovery of the gas from a given reserve. An example of this is a case in which a given block of acreage has nine times the reserve of another block, the only difference in conditions being that of sand thickness. Although this is an extreme difference, minor differences do exist from field to field.

In addition to the one consideration of pressure already referred to, formation pressure has another bearing upon processing cost. The higher pressures naturally require a greater investment in compression equipment and lines.

For the present at least, each project must stand on its own merits. Prospective processors, however, should not overlook the Natural Gasoline Association schedules as a guide in the ultimate development of a uniform practice. In the last analysis, it must be remembered that under existing conservation laws, distillate-laden gas may not be produced unless there is a market for the gas. Even when there is such a market, the sale of the gas will result in reducing the pressure in the reservoir and bring about condensation in the formation, resulting in the distillate being lost forever for production. A pressure-maintenance or recycling plant must be installed to prevent this loss.

Thus, unless recycling is practiced, no return at all may be available to the working and royalty interests and, if gas is produced with the oil from the same or interconnected horizon, the distillate income may be lost, due to retrograde condensation causing the distillate to condense in the gas sand. It is only because the producer or operator is willing to put money into the plant that an income is possible at all. It is of first importance, therefore, to return the investment on such an enterprise. Finally, too, the production from a distillate well is usually 25 to 50 times that taken by a natural gasoline plant from a well producing casinghead gas.

Experiments on Diffusion

Among the many unknowns in recycling is the behavior of gas when returned to a lime formation. Thus far, one plant is operating on gas produced from a lime section. Experimental field work has shown, however, that despite low permeability, large quantities of gas have been returned to the formation without material changes in pressure. In a recent 30-day test in a formation of exceedingly low permeability, the input well stabilized at a given pressure shortly after the operation was begun and remained constant to the end of the run.

In another test in another lime area, substantial quantities of dry gas were returned to the formation with similar results. It is highly probable that it would be found after a longer experience, that lime formations will behave like sand formations as far as "taking" gas is concerned. No information is in sight on the extent of channelling that might occur in lime sections, but it is certain that to prevent "breaking through" the input wells should be situated as far as possible from the producing area.

The test last referred to was used by the operators to determine the extent of diffusion in a reservoir. After several billion feet of gas had been introduced into the formation, the gas was again removed from the input well, carefully measuring the production and observing its gasoline content. It was found that substantially the same amount of dry gas was taken from the well as had been introduced into it, and that when the dry gas was withdrawn, wet gas having the identical character of the formation gas was produced.

On the other hand, small scale experiments at low pressure, and a field experiment wherein nitrogen was introduced with natural gas in a partly depleted field, have shown that some amount of diffusion will be experienced and that allowances must be made therefor.

Future Development

Of considerable concern are questions of legislation, which would impose restrictions upon recycling operations. Some restrictions designed to prevent drainage might be constructive, but when legislation enters, it is any man's guess where it will stop. It is possible that some form of regulation may develop out of the recent Federal Court decision in an East Texas proration case. An acreage factor in any sort of proration yardstick is inherently fair in oil or gas proration, and its ultimate introduction in recycling regulation should not affect adversely the legitimate rights of a plant operator, or the working or royalty owner's interest.

It has been emphasized by those who have publicly discussed recycling that, important as unitization is elsewhere, it is virtually mandatory in a recycling project, where acreage is divided. Not only can unnecessary wells be avoided, but a better well pattern can be made. In a pool in which royalty ownership is complicated by many divisions, it may not be possible to devise a development program in which there will not be wells improperly located, if gas must be returned to the same leases from which gas is produced. Input wells improperly located will presently encroach upon producing wells and destroy their utility, and make for a considerable diminution in the ultimate recovery of wet gas from the reservoir. Various arrangements have been suggested, but manifestly the best one is when all the leases can be pooled and each lease credited upon some basis of acreage and wells. As a corollary to this, it follows that when more than one plant is planned for a field, complete coöperation between the operators will be conducive to best results.

When recycling can be justified, it opens a means for exploiting the distillate content of a gas reserve without destroying the value of the gas reserve for use as and when a market is available. It is too late to begin the extraction of distillate when part of the gas has been sold on the fuel market. If crude oil is produced from the same or an interconnected horizon, the gas produced with the oil will eventually reduce the pressure in the gas-distillate section, and bring about condensation in the formation. Recycling makes possible the recovery of a large part of the distillate before pressure decline from any source has brought about this liquefaction.

Whichever way recycling is viewed, it is conservation par excellence. The practice of recycling should be encouraged by public regulatory bodies. The exploitation of a gas-distillate reserve without recycling or pressure maintenance is the negation of conservation and results in the waste of an irreplaceable, valuable natural resource, and will not long be countenanced.

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Practical Application of Gas Laws to Distillation and Storage Problems

Steam continues to have important function in distillation even though tube heaters have obviated its use to prevent local overheating

By
R. G. LOVELL
Development Engineer, Hancock Oil Company

THE law of physical science upon which this article is based may be stated thus:

The vapor pressures of any dissimilar liquids are separate and additive at any temperature or pressure, but any one liquid in a mixture of dissimilar liquids will boil at a temperature below that at which it would boil if isolated.

From the viewpoint of the production man a mixture of oil and water forms one of his most troublesome problems. He selects the most suitable method for separating the two liquids sufficiently that the water-oil ratio does not exceed the requirements of "pipe line oil."

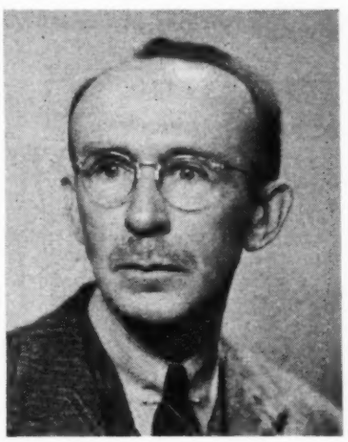
This water (usually salty), still in an emulsified state, would not be undesirable in the refinery if it were fresh water. In fact, it might be desirable. Nearly all oil-water emulsions from the well are salty, however, so the refiner must evaluate the two major reasons for the separation of the emulsion. Many chloride compounds cause no operating difficulties other than those resulting from the deposition of crystalline solids and wax in the primary heat exchangers, but others are of such chemical and physical nature that they are able to react with some of the hydrogen compounds released in cracking and form hydrochloric acid.

The present discussion is based upon the assumption that salts of this type are not present, and that the water in the oil to be processed is non-corrosive and does not exceed three percent.

The Phenomenon of Boiling

The molecules of any substance, at any temperature above absolute zero, are in a state of more or less violent movement, depending upon the nature and temperature of the substance. Absolute zero, minus 460°F., is that temperature at which there exists no molecular movement.

Beginning at a temperature of 32°F., the temperature at which water changes from a solid to a liquid at atmospheric pressure, this molecular movement increases with increase in temperature. As heat is added to the water, eventually a temperature is reached at which this movement becomes so violent that the surface tension of the water is broken and vapor issues. As additional heat is added to the water the molecular movement becomes still more violent, the vapor penetrates the blanket of air, and boiling ensues. This boiling continues only so long as enough heat is added to the water to provide the energy consumed by vaporization. The energy required to overcome the pressure above the liquid varies directly as that pressure. Atmospheric pressure, in turn, is a function of the density of the air. The air at sea level is compressed by the weight of air above it and, consequently, is more dense and exerts greater pressure per unit of area than air at higher altitudes. More heat, therefore, is required to cause water to boil at a low altitude than at a high one. By the same reasoning it will be clear that, because a greater amount of work is required to evaporate the water into steam at sea level, more work can be recovered from the steam, and a greater amount of cooling water is needed to condense it.



R. G. LOVELL

received his academic training in New York, after which he served several years in the Engineering Department of the New York Telephone Company—Went to Bisbee, Arizona, in 1908 where he "cut his mechanical engineering teeth" in one of the first large power plants of the Southwest, that of the Copper Queen Mining Company, later the Phelps-Dodge.

He next went to Mexico where he remained until 1917 and returned to enter the military service for the period of the war—Returning to Mexico after the war he served the Alvarado Mining and Milling Company of Parral as general master mechanic for two years.

Lovell left mining and went into petroleum in 1920 with the Standard Oil Company of California and since that time has been continuously associated with the oil industry, chiefly in manufacturing. His engineering career has included a wide range of practical experience with mechanical and electrical equipment in both the mining and petroleum industries—Has specialized in pumps and pumping.

For many years he has been with the Hancock Oil Company of California at Long Beach and now devotes his time largely to process and equipment development — Has also been in charge for five years of the classes in the Oil Refining Division of the Trade Extension School operated by the City of Long Beach.

Two-Component Liquids

The action of a mixture of two liquids of different nature will be quite different from that of the water just described. That part of Dalton's law wherein it refers to the partial vapor pressures of dissimilar liquids may be re-stated thus: *The fraction of the total vapor pressure that is exerted by any one gas in a gaseous mixture is proportional to its volume percentage (mol percent) in the mixture.*

In heating a body of oil containing a small quantity of water it will be noted that even before boiling occurs the molecular movement of the mixture is more violent than if there were no water in the oil. The physical effect of the movement is the formation of a

vapor pressure, so that the total vapor pressure of the mixture more quickly overcomes the surface tension. It must be remembered, however, that the surface to be broken is oil and that, although the surface tension of oil is less than that of water, the internal friction, or viscosity, of the oil is greater and, consequently, more force is required to rupture it and permit vapor to escape. This effect is offset by the fact that the temperature of the oil would have reduced the viscosity of the oil.

The issuing vapor has a pressure that is the sum of the partial vapor pressures of the two liquids. The boiling point of the oil will depend upon the relative quantities (mol percents) of the two liquids. If the water in the charge stock greatly exceeds 3 percent it would be necessary to reduce it to that amount, and if the use of steam is being considered, it would be practicable to use just enough steam to control the end point and flash specifications of the desired overhead products.

Application of the Theory

A definite line must be drawn between the chemical structures of the fluids under consideration. Water is a compound of hydrogen and oxygen and, consequently, has one distinct temperature at which it will boil under any given pressure. Crude oil is a mixture of, perhaps, many hundreds of compounds of carbon and hydrogen, together with sulphur compounds and other impurities. It will be obvious, therefore, that the lightest of these compounds will vaporize at a temperature at which the heavier ones will not.

In the days of the shell still it was the custom to use "bottom steam." That is, the steam was introduced near the bottom of the still and, by its mechanical action, served to prevent overheating of the oil by inducing more rapid circulation. When the batch system was used the fires under the still were increased as each group of fractions vaporized. The quantity of steam was also increased proportionately for manifest reasons. For continuous distillation, a battery of stills in series was used, and the steam and fires were increased progressively from the initial to the terminal still of the series.

How Tube Heaters Change the Practice

Now that the shell-type still has been supplanted by the continuous tube-type heater, which has many advantages, the process is changed.

Although steam is not necessary in the tubes to avoid local overheating, because the velocity of the oil prevents this, at least an amount of steam equivalent to that used in the shell still is necessary. Distillation has two distinct functions: first, to evaporate all the fractions that are to be recovered as overhead products and, second, to separate each from the other overhead fractions. This cannot be done, as it was in the shell still, by varying the temperature because the temperature required to vaporize the heaviest of the overhead cuts determines the temperature to which the entire body of the crude must be raised. For most crude oils this temperature exceeds that at which the lighter fractions decompose, and some means must be found to complete the vaporization at a temperature low enough that the gasoline will not be ruined.

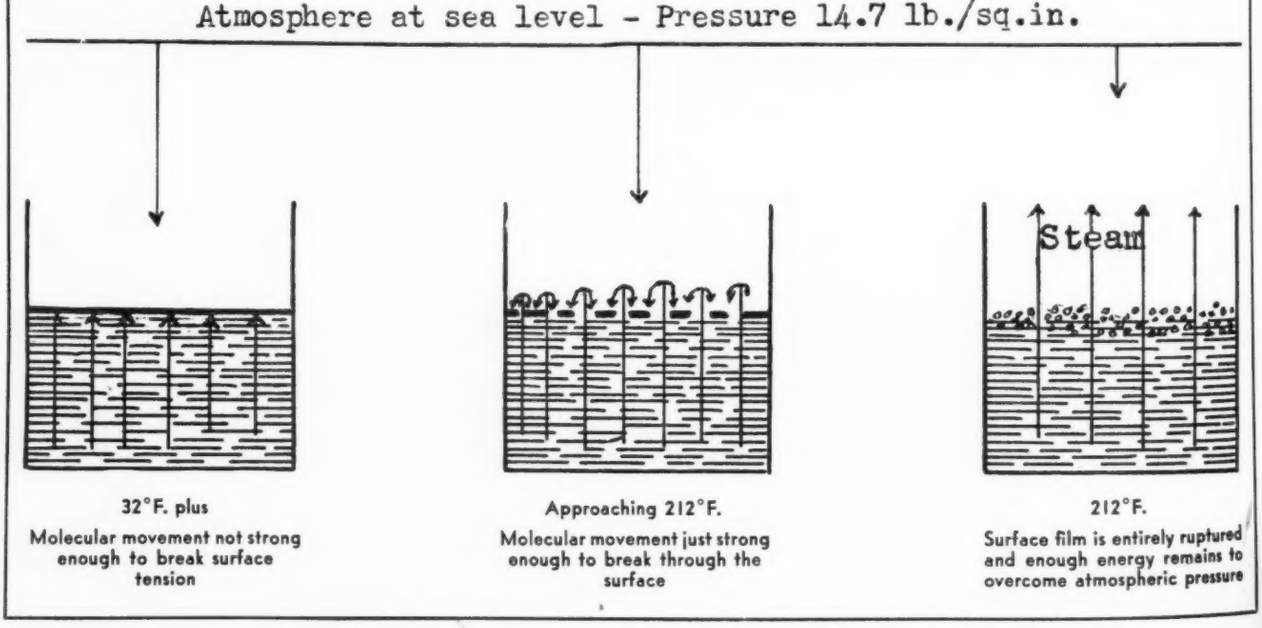
Proper point for steam entry. As intimate a mixture of the two liquids as is practicable is advantageous. Water might be introduced in proper proportion before the oil goes to the heater. This is correct in theory, but unwise in practice, because the mixture, as soon as it has attained a moderate temperature, becomes frothy. This froth, or foam, has low heat conductance and causes hot spots. There is no objection, however, to introducing the steam or water into the transfer line at the outlet from the heater. This will allow time for the water vapor to become thoroughly mixed with the heated oil, and will undoubtedly result in a rapid vaporization at the point where the transfer line enters the fractionating tower.

Use of Superheated Steam

Hardly a man will read this article who will not have heard the recurring arguments over the relative value of saturated and superheated steam as an aid to distillation. By the application of the fundamentals herein expressed, the argument can be settled. First assume a typical problem of vaporizing a crude oil charge stock that must be heated to a temperature of 700°F. in order to separate the gas oil, kerosene, distillate, naphtha, and gasoline frac-

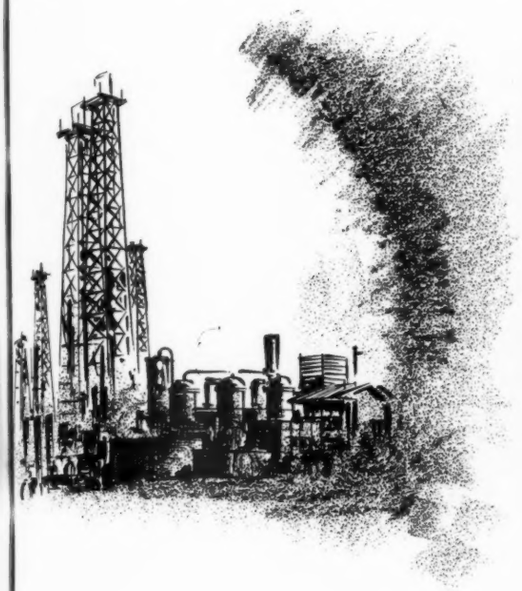
(Continued on Page 38)

The three phases of boiling a simple compound—water


Atmosphere at sea level - Pressure 14.7 lb./sq.in.
Steam
32°F. plus
Molecular movement not strong enough to break surface tension
Approaching 212°F.
Molecular movement just strong enough to break through the surface
212°F.
Surface film is entirely ruptured and enough energy remains to overcome atmospheric pressure

OF OURS ◆ ◆ ◆ ◆

and the lot of those who serve it



North Bigbee

THE AUTHOR selected to prepare the series of articles announced on the opposite page, North Bigbee, has enjoyed a rich experience in oil writing beginning with the fall of 1930 when he was assigned to the newly-created position of oil editor of The Dallas *News*. This occurred simultaneously with the bringing in of the discovery well in the East Texas field, and for seven years thereafter Mr. Bigbee was editor of the oil page on that daily. During the time *The News*' oil page became known for its championship of the rights of the oil-producing companies, both independents and majors. *The News* fought for control of production by the individual states and then, as now, was a considerable influence in Texas, in which state the question has ever been most acute.

He has written for a number of national magazines, including *Fortune* and *Today*, and was at one time connected with Rinehart's oil reports. While he was yet writing his daily column, "Swabbings," for the Dallas *News*, Mr. Bigbee was picked by *Time* magazine as one of the dozen outstanding business columnists of the country.

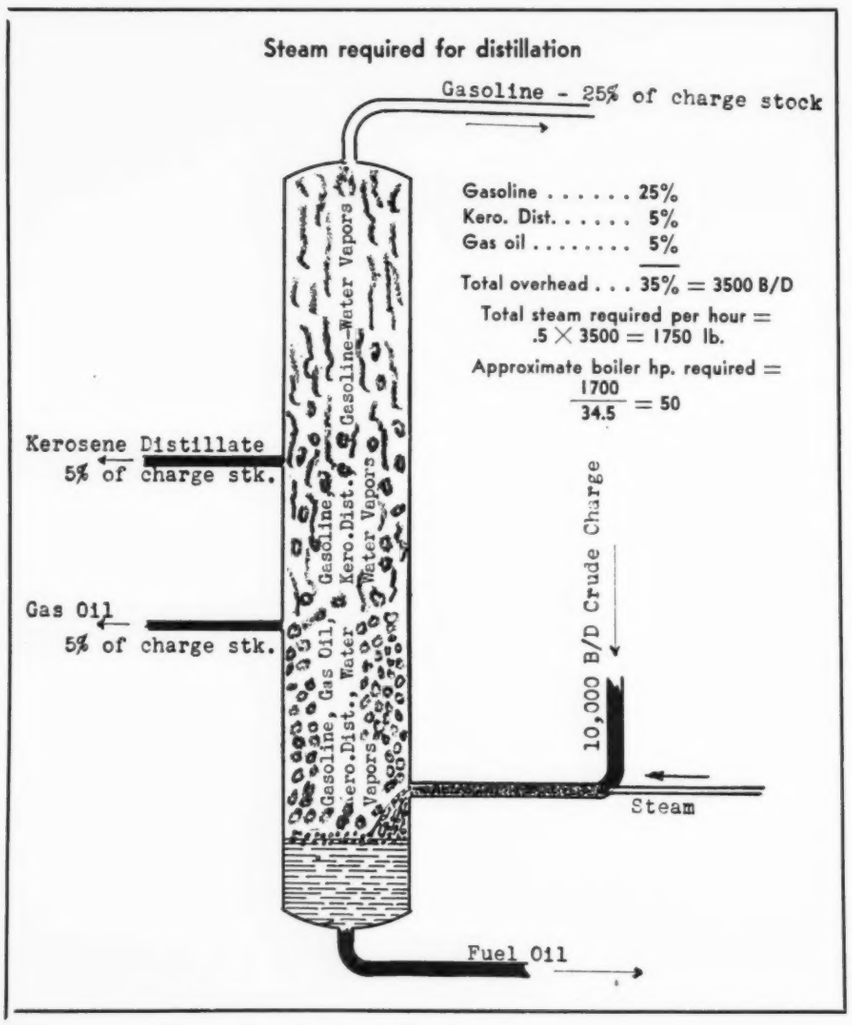
Among other oil-writing experiences, Mr. Bigbee formerly handled publicity for the Mid-Continent Oil and Gas Association.

September issue of the Petroleum Engineer

(*Continued from Page 34*)
tions from the heavy bottoms. Experience has demonstrated that a temperature of 700°F. will crack the gasoline fractions and, because the oil is distilled at low pressure, this will result in a sour product. Experience has also shown that a reasonable amount of steam mixed with the oil will reduce this temperature to 500°F. As has been stated, this is entirely a matter of the relative quantities (by weight) of the oil and water (source of the steam). The temperature of exhaust steam at a pressure slightly greater than that in the bottom of the tower, say 15 lb. per sq. in. gauge, will be 250°F. As steam comes into contact with the oil it must, necessarily, assume the same temperature as the oil, taking heat from the oil in doing so. If high-pressure steam is to be used at 150 lb. per sq. in., its temperature will be 366° even when its pressure has been reduced by expanding to tower pressure. True enough, this expansion would tend to reduce the temperature to that of steam at a pressure equivalent to the tower pressure but, because the temperature of the oil in the lower section of the tower is 500°F., the steam temperature must rise to the same point, acquiring superheat in so doing. It is entirely a matter of using the charge stock to raise steam temperature. The writer has had excellent results from injecting normal steam into the transfer line and permitting the oil to leave the heater at a temperature enough higher to permit it to give up some of its heat to the steam.

Behavior of the Steam in Fractionation

In the vaporizing stage of the distillation, the action of the steam may be defined as the "roughing-in" of distillation. The duty of the steam in fractional distillation is subject to the same laws and is different from simple vaporizing only as it is more complex. Each unit of the water vapor has performed its chemical function upon its proportionate share of the incoming crude but has lost none of its capacity to continue this function as it passes along with the body of vapor. The temperatures at which the side-draws of gas oil and kerosene distillate condense and leave the tower are high enough so that very little of the steam leaves the tower with either of these cuts. More steam is necessary, therefore, in the side strippers, but this is not lost but passes on with the stripper overhead to the next higher section. Very little additional steam is necessary to control the overhead temperature and maintain the desired end point of the gasoline.


Steam required for distillation
Gasoline - 25% of charge stock
Gasoline 25%
Kero. Dist. 5%
Gas oil 5%
Total overhead . . . 35% = 3500 B/D
Total steam required per hour = .5 × 3500 = 1750 lb.
Approximate boiler hp. required = 1700 / 34.5 = 50
Kerosene Distillate
5% of charge stk.
Gas Oil
5% of charge stk.
Gasoline, Gas Oil, Kero.Dist., Water Vapors
Gasoline-Water Vapors
Kero.Dist.-Water Vapors
10,000 B/D Crude Charge
Steam
Fuel Oil

A Good Rule Works Both Ways

"It's a poor rule that will not work both ways." An instance wherein the rule did work in the opposite direction to the end that evaporative loss of gasoline, and the consequent loss of quality, were almost entirely stopped will now be described.

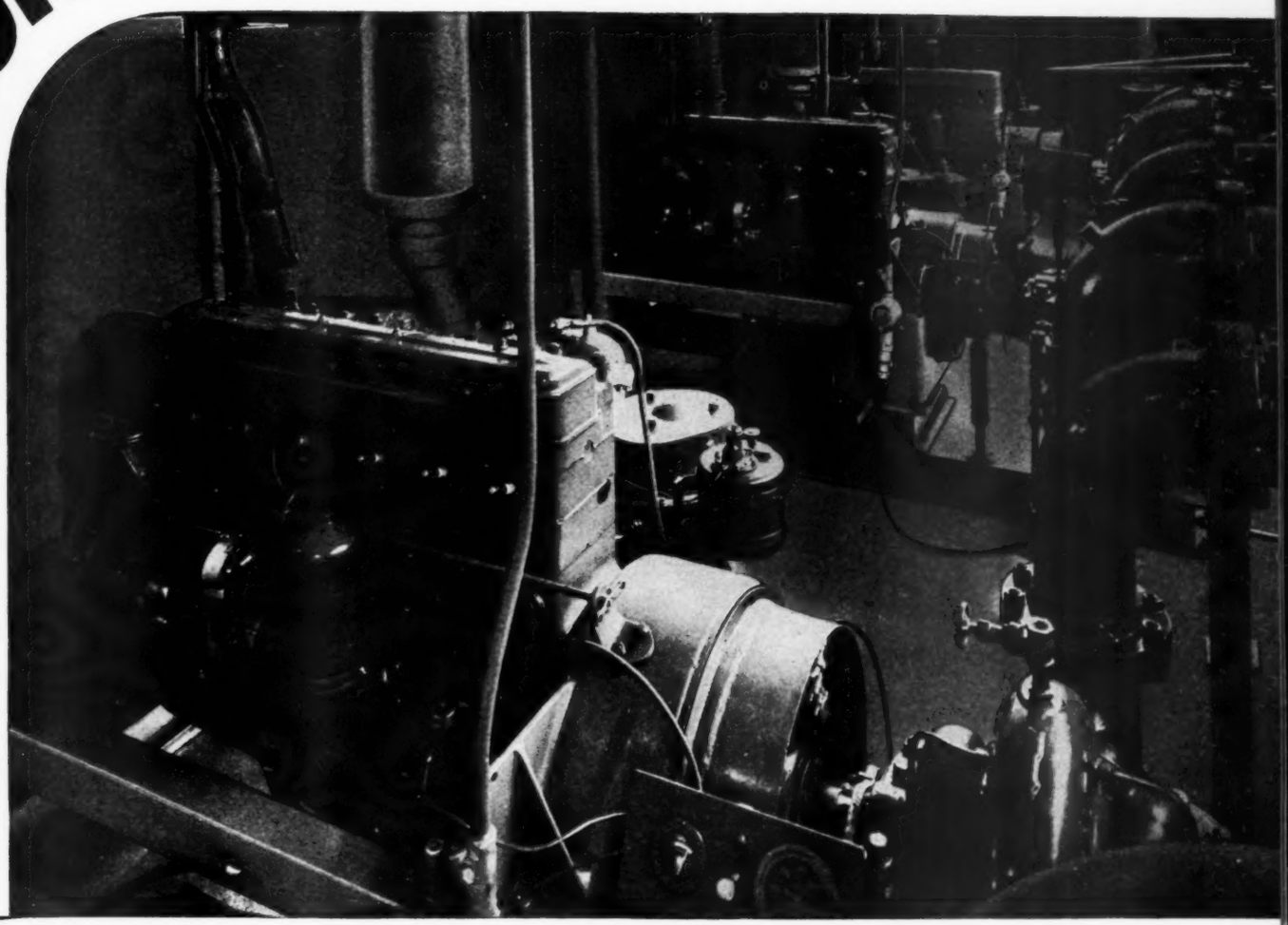
The problem was to prevent the evaporative loss of premium gasoline stored in and dispensed from a bulk plant situated where there was a large difference between day and night temperatures. The volume requirements and proximity to source of supply of the gasoline made possible the use of a tank of only 3000-gal. capacity, and deliveries to the tank were made in lots not exceeding 1780 gal.

The night and day "breathing" losses comprised almost all the loss and the conventional water-seal tank, equipped with pressure- and vacuum-relief valve set at 2 oz. and 4 oz. per sq. in., did very little to obviate the loss. If the breathing-out at times of high temperature could be stopped, there would be no breathing-in at low temperature. To restrain the gas from escaping involved maintenance of pressure in the tank. The maximum Reid vapor pressure of the gasoline to be stored in the tank was set at 8 lb. at 100°F.

Before proceeding further it is pertinent to note that the law governing the partial vapor pressures of two or more volatile fluids that are mutually soluble is not the same as the law, previously discussed, applying to dissimilar or immiscible fluids. Gasoline is a complex mixture of many components, all mutually soluble, and if the total vapor pressure of the mixture was the sum of the partial vapor pressures of each of the components, it would be very high. The rule for mutually soluble liquids is Raoult's law and takes into consideration the concentration (mol percent) of each component in the liquid.

The established procedure for measuring vapor pressure of gasoline is the Reid vapor-pressure test and the method is as follows: A small cylinder is filled with gasoline to be tested. An auxiliary cylinder, equipped with an accurate pressure gauge reading in lb. per sq. in. is washed with water to as-

CUTTING CORNERS ON COSTS



Power keeps the wheels turning . . . and INTERNATIONAL Power *keeps them turning at a profit.*

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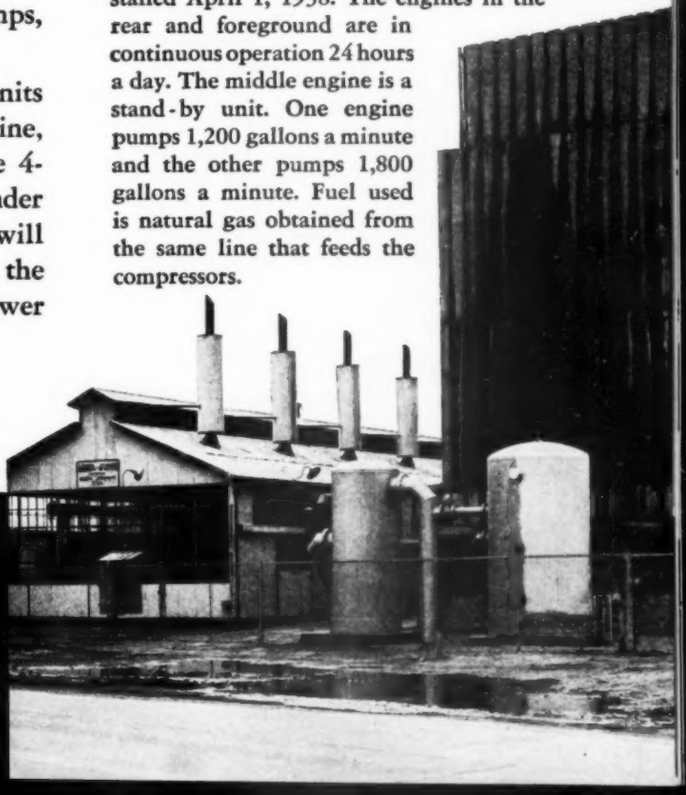
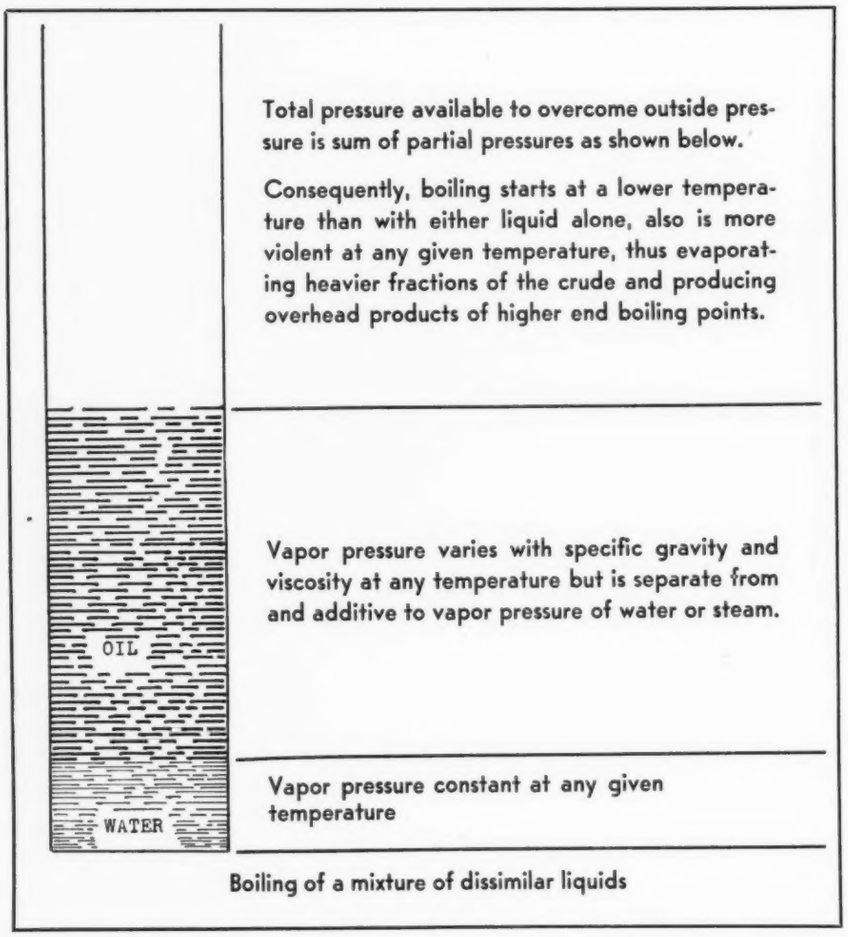
International Engines are available as compact power units in 11 different models, ranging up to 110 max. h.p. for gasoline, gas, Diesel, and distillate operation. The line includes five 4-cylinder models, four 6-cylinder models, and 4- and 6-cylinder Diesel engines. In this wide variety of types and sizes, you will find the power to fit your job. For complete information on the International line, see the nearby International industrial power dealer or Company-owned branch.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 North Michigan Avenue **Chicago, Illinois**

● The three International Engines shown above are operating centrifugal water pumps, circulating water through eleven gas compressors and the cooling tower, in the natural gasoline plant of the Lomita Gasoline Co., Long Beach. They were installed April 1, 1938. The engines in the rear and foreground are in continuous operation 24 hours a day. The middle engine is a stand-by unit. One engine pumps 1,200 gallons a minute and the other pumps 1,800 gallons a minute. Fuel used is natural gas obtained from the same line that feeds the compressors.



INTERNATIONAL INDUSTRIAL POWER


Total pressure available to overcome outside pressure is sum of partial pressures as shown below.
Consequently, boiling starts at a lower temperature than with either liquid alone, also is more violent at any given temperature, thus evaporating heavier fractions of the crude and producing overhead products of higher end boiling points.
OIL
Vapor pressure varies with specific gravity and viscosity at any temperature but is separate from and additive to vapor pressure of water or steam.
WATER
Vapor pressure constant at any given temperature

Boiling of a mixture of dissimilar liquids

sure freedom from vapors retained from previous tests, and is then screwed to the first cylinder and the connecting valve opened. The assembly is brought to a temperature of 100°F. and the pressure observed. Reid vapor pressure is not exactly the same as the true vapor pressure but the difference is so slight that it may be ignored and, if the Reid method is used consistently it is a satisfactory method of comparison. In establishing this standard test procedure it was necessary to select a standard ratio between the volume of the gasoline bomb and that of the expansion chamber. In the case of the gasoline tank, the ratio between the liquid and vapor space of the tank could not be constant, because withdrawals and replacements of the gasoline were frequent. When the ratio between the liquid gasoline and the vapor space in the tank was the same as that in the test apparatus, the pressure gauge on the tank, at a temperature of 100°, would measure the true Reid vapor pressure of gasoline, but as the vapor space diminished, as when the tank was being filled, the gauge pressure would be proportionately higher. As withdrawals were made and the vapor space increased the actual pressure would be less than the Reid, and some of the lighter components of the gasoline would evaporate into the vapor space. Although an equilibrium would quickly be established, and this evaporation checked thereby, the volatility of the gasoline would have been reduced.

A pressure of 10 lb. per sq. in. was selected as the pressure most likely to fit all conditions. Accordingly, the pressure-relief valve was set to relieve at that pressure, and the tank was charged with gasoline. To avoid opening the tank for gauging a vapor-tight gauge was installed.

The tank has been in service for more than a year and no particular effort has been made to maintain any definite relationship between the liquid and vapor volumes. Another tank of 4000-gal. capacity has since been erected in another area where similar temperatures prevail and this also has been eminently satisfactory.

The total cost, including all valves and the special gauge, does not exceed the conventional design by more than 30 percent. The tanks are set vertically to reduce liquid surface to a minimum and are fabricated with spun bumped heads.

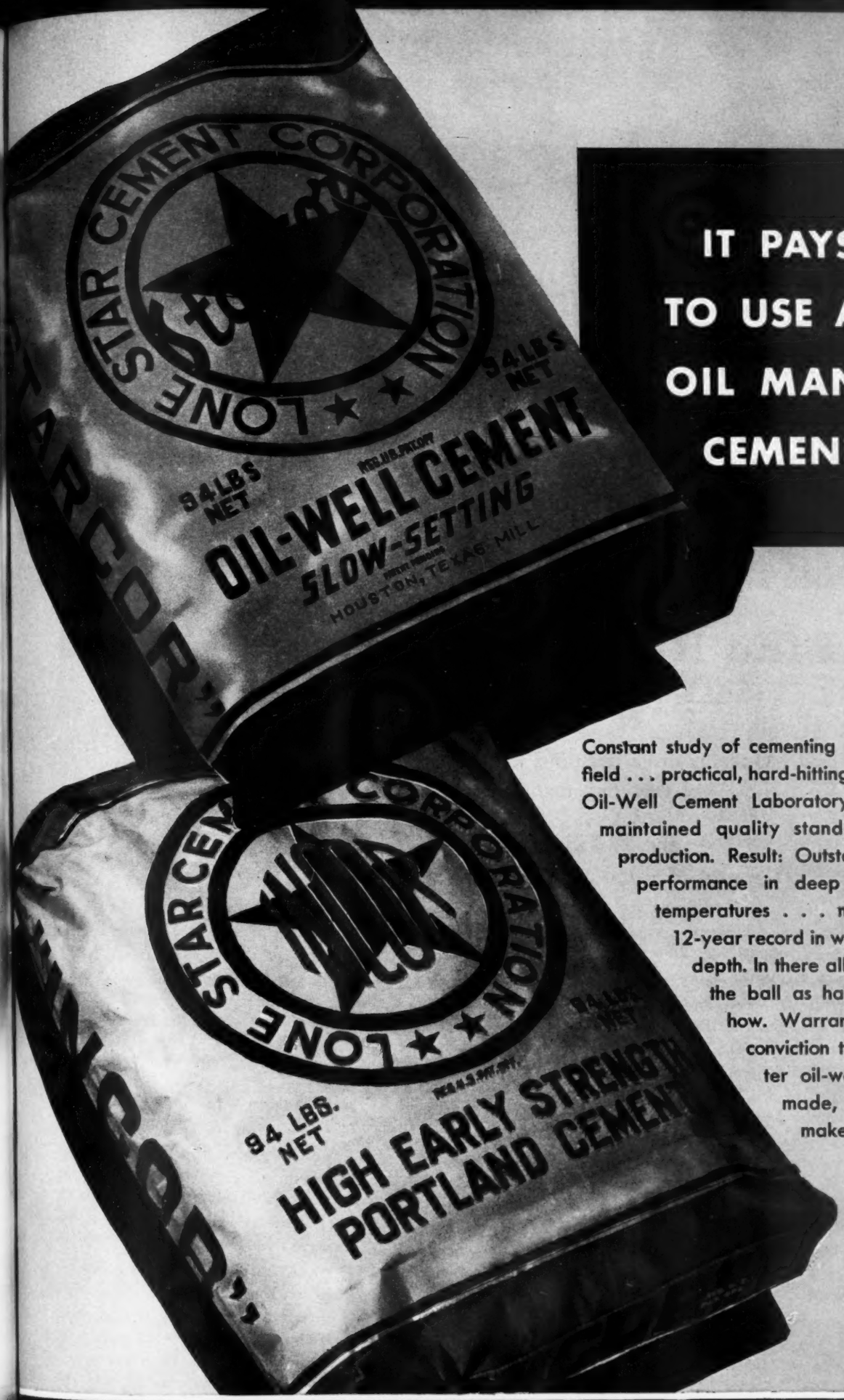
Limits of Inflammability of Gases and Vapors

A knowledge of the limits of inflammability of methane and other combustible gases both in air and in partly vitiated atmospheres is of fundamental importance in the study of mine explosions and their prevention. Likewise, a knowledge of the limits of inflammability of gasoline and benzol vapors, natural and manufactured gas, blast-furnace gas, hydrogen, acetylene, and many other gases is of equal importance in the prevention of gas explosions and fires in the metallurgical, petroleum, gas-manufacturing, and related industries.

The importance of such data is shown by the numerous inquiries received by the U. S. Bureau of Mines for information on the limits of inflammability of combustible gases and vapors in air and oxygen, mixtures of complex combustible mixtures, both in air and in atmospheres containing various proportions of added inert gases; the effect of temperature, pressure, and humidity on the limits of inflammability; and how inflammable mixtures may be rendered free of explosion hazards by changing and controlling the oxygen concentration of the atmospheres.

Combustible substances, which a few years ago were made only on a small scale in the laboratory, are now being made and used on a large scale. Many of these newer substances form dangerously explosive mixtures with air. Data concerning their limits of inflammability are widely scattered in the literature and many of the values reported seem contradictory. In a revised edition of Bulletin 279, "Limits of Inflammability of Gases and Vapors," by H. F. Coward and G. W. Jones, a comprehensive survey covering the period from about 1800 to the present time has been made and more than 100 new references added. The data have been arranged, coördinated, and critically reviewed. Many values on the limits of inflammability of gases and vapors are given that have not hitherto been published.

Copies of the bulletin may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 20 cents.



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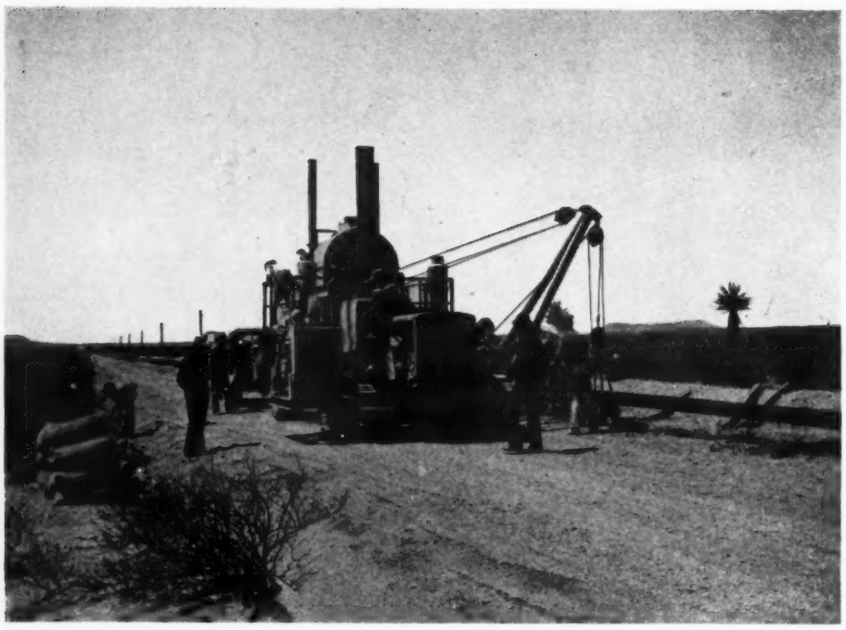

Special equipment designed for operation over the trench

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Pipe Line Reconditioned and Coated While in Operation

Only 59 days required to complete 25-mile section of 8-in. line using special equipment

By WALLACE W. COLLEY
General Manager, Industrial Engineering Company

THE recent completion of a 25-mile reconditioning and coating contract on the 8-in. line of the Pasotex Pipe Line Company in West Texas is attracting more than usual interest because of the speed with which the job was completed. The protective treatment was applied in 59 days elapsed time; maximum coating progress was 5285 ft. in 8 hours, 10 minutes. Because of the increased interest in asphalt-mastic as a source of long-time corrosion prevention and because the Pasotex job was accomplished by using recently designed special equipment that permits lines to be coated while in operation, the work was inspected by representatives of several oil and gas companies. The reconditioning and coating contract was awarded to Industrial Engineering Company, Los Angeles, California, and the asphalt-mastic protective material used was Somastic pipe coating.

As this line is the only source of crude oil for the El Paso territory it was necessary to maintain the line in service at all times. The 25-mile section treated comprised short sections through the more corrosive areas between El Paso and the Hueco pump station.

Preliminary work included landowner contacts and permits of access, and the preparation of all roads and other crossings, including the construction of safety crossings for livestock. Because of prevailing high winds, workmen were equipped with goggles and dust masks. Sections to be treated were marked, pipe was located, necessary gates and crossings were built, and the right-of-way then graded with an angledozer-equipped tractor and made ready for the trenching machine and other equipment.

Pipe was uncovered by a ditching machine. The trench was excavated to a width of 28 in. and to an average depth of 20 in. To eliminate undue strain on the pipe while raising, material was completely removed from the pipe by a 36-in. shoe riding on top of the pipe and attached to the frame of the digging wheel.

Raising, Skidding, and Cleaning

Pipe was raised by a truck equipped with a sideboom winch and hoists, and placed on double skids spaced at 40-ft. intervals. Short lifts were made at close intervals, using cross skidding for support while raising.

Loose dirt and other debris were removed by hand, and the pipe then cleaned by a traveling-type cleaning machine equipped with scrapers, knives, and cutters. To procure a perfect bond of primer to the pipe, the latter was sandblasted. In the opinion of the contractor, an important phase of any coating job is obtaining a firm

bond of material to pipe. Particular attention was given to the cleaning of pit holes and the edges of patches.

Three sets of sandblast machines having ¼-in. nozzles were used. Air was supplied by two 310 cu. ft. compressors drawn by two 30-hp. tractors. Sand screened through No. 20 mesh screen was used.

The sandblasting operation was performed in two stages. The first crew, operating two nozzles, cleaned the major part of the pipe; and the second crew, operating one nozzle, blasted the bottom of the pipe. All deep pits were then electric spot-welded, and pipe was double soled where necessary.

Paint Material

Priming. After the sandblasting operation, the pipe was painted with primer, using two pressure spray guns. Primer was evenly distributed and special attention given to eliminating extra thickness and "dew dropping" on the underside of the pipe.

Coating. Preliminary to the application of the protective coating, materials for the asphalt-mastic were procured, weighed, sacked or packaged, and strung along the right-of-way. These coating materials consisted of non-micaceous sharp sand in 90-lb. sacks, carefully screened to assure maximum density; commercial limestone dust—100 percent passing No. 50 mesh screen and 80 percent passing No. 200 mesh screen, in 88-lb. sacks; air-blown asphalt conforming to Somastic pipe coating specification No. 1, supplied in 100-lb. cartons; and long-willowed asbestos fiber, packaged in 100-lb. sacks. Maximum density was obtained by using 66.8 percent sand, 20.2 percent lime dust, 12 percent asphalt, and 1 percent asbestos. Average progress of 4000 ft. per 8-hr. day required approximately 55,000 lb. of materials to be mixed.

Application of Coating

The coating was applied by equipment especially designed for operation over the trench. The coating material was prepared in a mobile hot plant consisting of loading skip, aggregate dryer and heater, asphalt heater and pump, two mixing pug mills, and conveyor system.

The equipment operates in the following manner: A special traveling expanding extrusion nozzle and drive, electrically operated, receives the material from the mixing plant by means of heated screw conveyors, discharging into a hopper situated above the nozzle. The hot material is pumped into the extrusion chamber under pressure, and the forward positive drive of the nozzle extrudes the coating uniformly on the pipe to a thickness of ½ in., at speeds varying from 8 to 14 lineal ft. per min.

The nozzle is equipped with expanding quadrants that allow for coating over patch plates, high welds, and other irregularities. A central horizontal and vertical axis is maintained at a point between the traveling drive and the nozzle, making it possible to apply uniform coating on vertical and horizontal bends in the pipe line.

Steady, slow-speed travel of the mixing plant, the electrical operating power, and cradling of the pipe are supplied by a special tractor equipped with a sideboom and aerial dolly, and a 30-kw. generator driven by a Diesel engine mounted on the counterweight side of the tractor. This generator assembly eliminates the need for counterweights, and supplies sufficient counterweight to permit a boom extension when necessary. The sideboom tractor is connected by a drawbar to the front of the mobile hot plant. In rough country the proper level of the mixing plant is maintained by means of an adjusting screw. A flat trailer bearing materials is drawn behind the mixing plant to facilitate the chopping of asphalt, and charging material to the skip and asphalt-melting tank.

Testing

Prior to lowering-in, all coating was carefully tested by a holiday detector employing approximately 100,000 volts. The use of high voltage and uniform detector ring assured a valid test of quality and proper application of the finished coating.

After testing, pipe was lowered into the trench by sideboom truck and hoist. Prior to lowering the pipe, the bottom of the trench was prepared to offer a uniform bed, devoid of rocks and other debris. The trench was backfilled by an angledozer, the pipe-line maintenance road was graded, and the right-of-way cleaned-up, leaving the finished job neat and workmanlike.

This mobile equipment makes possible the application of protective coatings to both screwed and welded lines while in operation. By its use the contractor was enabled to apply coating to the pipe line at an average speed of ten lineal ft. per min., applying from 50,000 to 70,000 lb. of dense protective coating in each 8-hr. shift.

Close-up showing application of hot coating to pipe line while in operation

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❸ **"UNION-formed" 6x16 Filler Wire with Hemp Center,** for Kansas fields. This line was designed by Union engineers especially for use in Kansas, and it definitely overcomes difficulties experienced by Kansas operators with other constructions.

Recent experience has proved that pre-formed rope, though slightly higher-priced, makes the most economical Rotary Drilling Line. This is because Rotary lines must withstand severe bending, drum-grinding and crushing. "UNION-formed" lines are slower to fatigue under repeated bending because the individual wires and strands are stress-free as laid into the rope. It also wears longer under drum grinding and crushing because the exactly formed wires unite their strength to give the rope a firm body—and because when outside wires become worn they do not arch in the strand but lie flat.

The photograph was taken at a Superior Oil Company well just outside of Shreveport, drilled by F. W. Martin & Company. The men, left to right, are: R. N. McDowell, derrick man; J. A. French, helper; W. J. Craig, foreman; J. C. Sartor, derrick man; J. E. Womack, driller; C. C. Gilger, drilling supt.; C. M. Womble, driller; W. J. Morris, fireman; Paul Cooper, H. M. Markham, and J. C. Carroll, helpers; C. C. Robinson, Union Wire Rope Corp.

ROPE "DON'TS"

Don't neglect lubrication of wire rope, for best results. Rusty ropes become stiff and unbalanced, causing one-strand breaks, as above shown. Rusty wires lose fatigue properties and chafe each other and the core. A thin, heated oil that penetrates to the core is the best rope lubricant.

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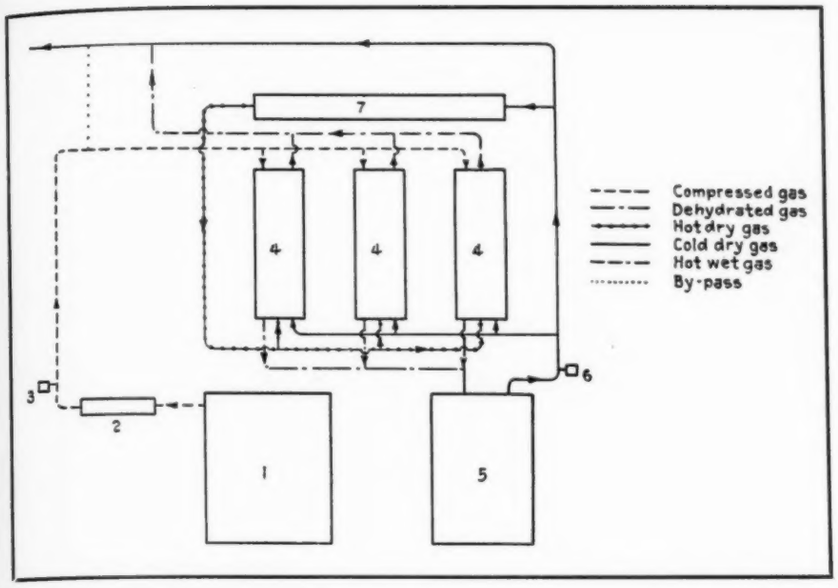


Fig. 1. (1) compressor plant. (2) water cooler. (3) gasoline accumulator. (4) absorbers. (5) refrigerating plant. (6) gasoline accumulator. (7) gas heater

A PETROLEUM ENGINEER FEATURE

Dehydration of Natural Gas by Silica Gel

Installation in Mene Grande field, Venezuela, dehydrates gas at a cost of .034 mill per M cu. ft. for silica gel only

By

H. de RAAY

Petroleum Engineer, Dutch-Shell Group, Naarden, Holland

AFTER the articles by J. R. Cowles[1] it would be superfluous to point out the importance of the dehydration of natural gas. Cowles also gave a description of the different methods at present in use to overcome freezing-up troubles by ice and/or hydrates. As a means of avoiding this trouble silica gel is mentioned and a theoretical plant designed by A. B. Allyne is discussed.

In the Mene Grande field, Venezuela, a silica gel plant for the dehydration of natural gas has been in successful operation for many years.

Purpose of dehydration. Natural gas is compressed to obtain gas of sufficient pressure to use as a production agent and to aid in the extraction of gasoline.

To increase the gasoline output the high-pressure gas is first cooled in a refrigerating plant in which a portion of the high-pressure gas is expanded.

Gas after compression is saturated with water vapor and, as it is thereafter cooled below the freezing point of water, freezing may be expected if this water vapor is not extracted prior to cooling.

Dehydration. The water content is extracted in a silica gel plant installed between the outlet of the compression plant and the intake of the refrigerating or expansion plant, as shown in Fig. 1.

The amount of water to be extracted can be easily calculated when the volume, pressure, and temperature of the gas at the various stages is known.

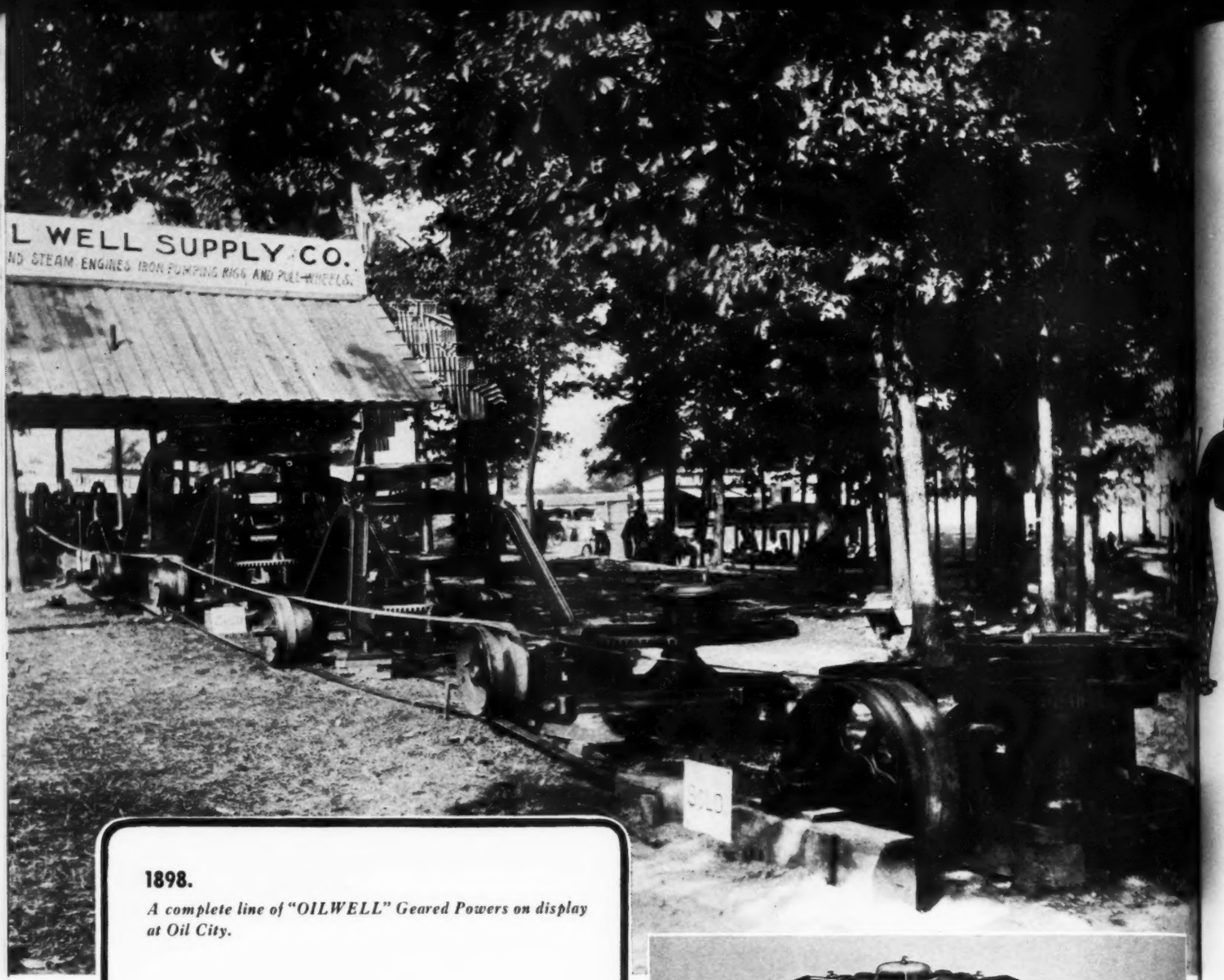
The silica gel plant. The plant consists of three absorbers and one heater. The principle of operation is analogous to that of a charcoal absorption plant in that one of the three absorbers is employed to absorb the water, while another is being dried by heated dry gas, and the third is being cooled by cold dry gas. The water is absorbed by

(Continued on Page 48)

H. de RAAY

graduated from Technical College, Amsterdam, Holland, as a mechnical engineer—Has served on the staff of the Dutch-Shell Group in many parts of the world—His experience has been in the production, engineering, and gas departments of that organization.

[1] "The Dehydration of Natural Gas," by Jas. R. Cowles, *The Petroleum Engineer*, July, August, October, November, 1937.



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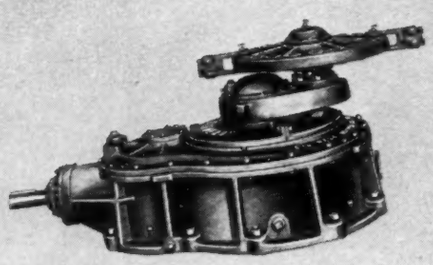
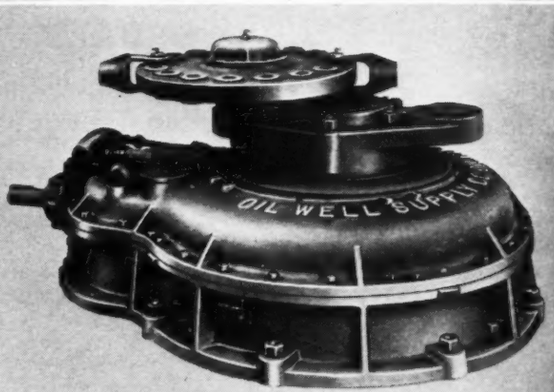


No. 30-SC

30 HORSEPOWER
AT 20 S. P. M.



No. 80-SC 85 HORSEPOWER AT 20 S. P. M.

No. 50-SC

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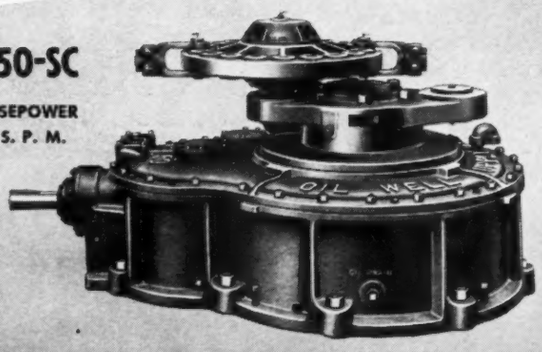
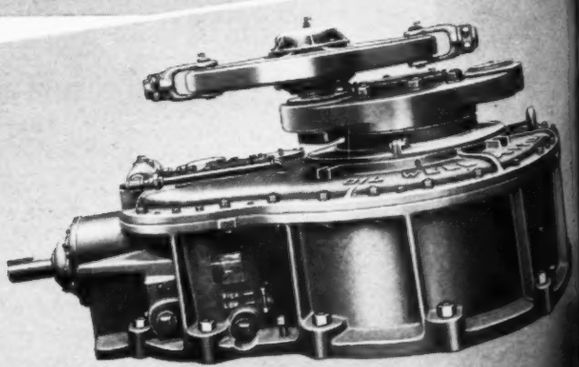
AT 20 S. P. M.





No. 100-SC 110 HORSEPOWER AT 20 S. P. M.

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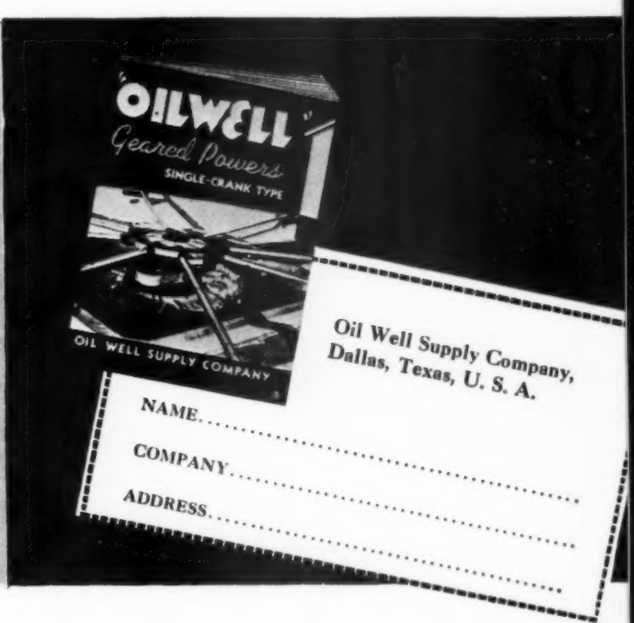

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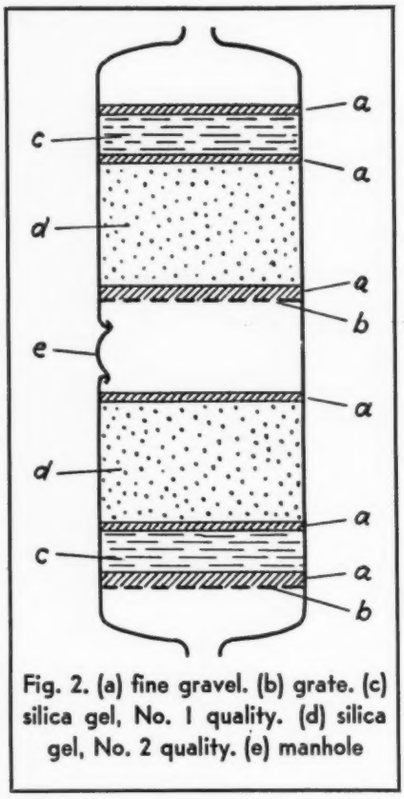


Fig. 2. (a) fine gravel. (b) grate. (c) silica gel, No. 1 quality. (d) silica gel, No. 2 quality. (e) manhole

(Continued from Page 45)

the silica gel of which two grades are used. The No. 1 quality has a very strong propensity for absorbing water and is so sensitive to the smallest quantity of water that contact with water will cause it to split and burst in pieces. Quality No. 2 is less sensitive and although being a good absorber is not reduced to powder when it comes in contact with water.

Each absorber is a cylinder fabricated of mill steel of sufficient strength to withstand the gas pressure. In each vessel two grates are installed, one near the bottom and the other halfway up the column. In this way the absorber is divided in two parts, as shown in Fig. 2. The beds of silica gel of different grades are divided by layers of fine gravel and gravel is also used to prevent the silica gel from being removed by the gas stream.

The gas heater is a standard tubular heater in which cold dry gas is heated by live steam.

The Operation

Absorption period. The high-pressure gas coming from the compression plant enters the top of the first absorber, leaves it at the bottom, and thence goes to the refrigerating plant. This is continued until the silica gel is saturated with water and then the gas stream is switched to the second absorber. After the second absorber, the third is used and so on, in cycles.

Heating period. A portion of the cold dry gas leaving the refrigerating plant is heated in the gas heater to a temperature of about 165°C. This heated gas is used to expel the absorbed water. The hot gas enters the absorber at the bottom and leaves at the top.

Depending upon circumstances, either high-pressure gas or expanded gas may be used as the heating medium. If all the high-pressure gas is required for gas-lift, the hot gas after expelling the water from the silica gel may be collected again in the high-pressure distribution system. If there is a surplus of high-pressure gas, or if part of the gas is used as fuel, it may be more efficient to expand part of the gas before heating it as in that case less gas is needed.

If the main objective of the total installation is gasoline extraction, the expanded and heated gas should not be returned to the intake of the compression plant after leaving the absorbers.

Cooling period. Another portion of cold dry gas is taken from the output of the refrigerating plant to cool the silica gel after water has been removed. This gas also enters the absorber at the bottom and after leaving it at the top is collected in the main lines.

The best and most efficient way to operate the silica gel plant has to be determined by experiment. Fig. 3 represents graphically a continuous operation of the plant.

During the absorption period a certain amount of gasoline is also absorbed by the silica gel. This gasoline is expelled during the heating period and is lost if expanded gas is used as the heating medium. If high-pressure gas is used for heating and is then returned to the wells for gas-lift this gasoline, although lost at the plant, may return to the compression plant with the gas from the gas-lift wells.

According to results of charcoal tests, the loss of gasoline is about 5 kg. per 1000 cu. m. or 0.06 gal. per M cu. ft. of gas.

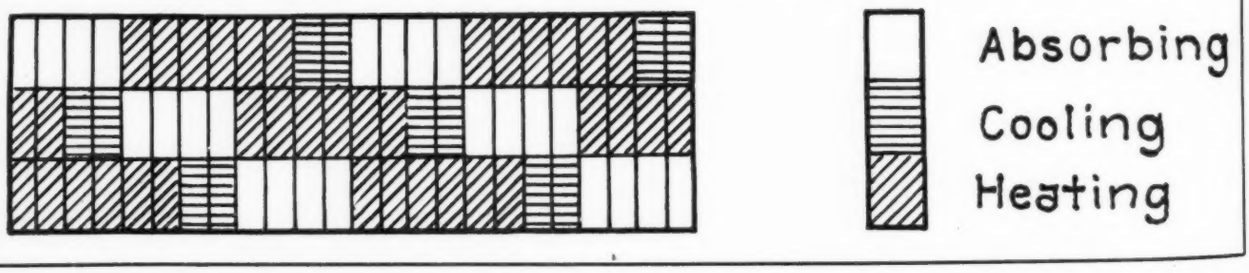
The pressure drop in the absorbers amounts to about 7 lb. per sq. in. The drop of pressure in the interconnecting lines, valves, fittings, etc., depends upon their dimensions.

OPERATING DATA—SILICA GEL PLANT

Intake, compression plant	250,000 cu. meters/day (metric units) 8,827,500 cu. ft. per day (English units)
Compressed to	25 atmos. (abs.) or 353 lb. per sq. in. (ga.)
Cooled by water to	30°C. (86°F.)
Cooled by refrigerating to	—5°C. (23°F.)
Daily water absorbed: $\frac{(250)}{(25)}$ (30—3.4)*=	266 kg. per day (metric units) 586.55 lb. per day (English units)
High-pressure gas used for heating	50,000 cu. m./day (metric units) 1,765,500 cu. ft. per day (English units)
High-pressure gas used for cooling	20,000 cu. m. per day (metric units) 706,200 cu. ft. per day (English units)
Steam pressure (live steam)	10 atmos. (ga.) or 147 lb. per sq. in (ga.)
Steam used	10,000 kg. per day (metric units) 22,050 lb. per day (English units)
Temperature heated gas	165°C. (329°F.)
Amount of silica gel in three absorbers	1600 kg. (metric units) 3528 lb. (English units)
Cost of silica gel (approx.)	$3520.
Life of silica gel (approx.)	3 years
Cost of dehydration based on the cost of the silica gel only or	$0.012 per M cu. m. $0.34 per million cu. ft.

*gas of 30°C. saturated with water vapor contains 30 grams per cu. m. or 1.87 lb. per million cu. ft.
gas of —5°C. saturated with water vapor contains 3.4 grams per cu. m. or 0.21 lb. per million cu. ft.

Fig. 3—24-hr. cycle of three-absorber operation



THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 26

For the convenience of readers who wish to refer to the tables, each page carries in the upper right corner an index number that classifies the table according to subject matter.

All petroleum engineering literature may be indexed for reference according to the Dewey Decimal System as modified and extended for the petroleum industry by L. C. Uren, professor of petroleum engineering at the University of California. When classified according to these index numbers the material follows in a logical sequence and falls into several logical divisions, as illustrated by the following outline:

Nos. P000-P399—General
Nos. P400-P499—Drilling
Nos. P500-P599—Production
Nos. P600-P699—Transportation and Storage (includes Pipe Line)
Nos. P700-P799—Refining, including
Nos. P770-P799—Natural Gasoline, which may be classified in a separate division (as shown here) if of special interest to the user.

To aid the reader in using the Decimal system, a subject index arranged alphabetically will be published, beginning in an early issue.

INDEX TO TABLES*

Title of Table	*Index No.*	*Page*	*Issue*
Weight per foot of threaded and coupled pipe (based on A.P.I. formulas) (sheet 1)	P 094.110.2	53	Aug.
Flange bolt and gasket sizes (sheet 3)	P 094.111.2	61	Aug.
Horsepower limitations of power shafting	P 094.801.	65	Aug.
Length of A.P.I. standard rotary chain (sheet 1)	P 425.212.	57	July
Net weight of 2⅜-in. drill pipe in rotary mud, lb.	P 425.240.237.1	55	July
Net weight of 2⅞-in. drill pipe in rotary mud, lb.	P 425.240.287.1	57	Aug.
Volume of liquid contained in drill-pipe strings, bbl.	P 451.2	55	Aug.
Volume of liquid contained in casing strings, bbl. (sheet 1)	P 535.132.	53	July
Volume of liquid contained in casing strings, bbl. (sheet 2)	P 535.132.	59	Aug.
Relative humidity and vapor pressure of saturated water vapor (sheet 1)	P 728.101.	63	Aug.

*This index of the third twelve installments is revised monthly as additional tables are published. A complete index of all tables included in the first twelve installments was published in the May, 1938, issue. The index of the second twelve installments appeared in the June, 1939, issue.

INDEX TO ADVERTISERS IN TABLES

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Brewster Company, Inc.	58	Aug.	P 425.240.287.1
Chapman Valve Manufacturing Co. (sheet 3)	62	Aug.	P 094.111.2
Fluid Packed Pump Company (sheet 2)	60	Aug.	P 535.132.
Hyatt Bearings Division, General Motors Corp.	54	July	P 535.132.
Jeffrey Manufacturing Company	58	July	P 425.212.
Larkin Packer Company (sheet 1)	54	Aug.	P 094.110.2
Macwhyte Company	56	July	P 425.240.237.1
Marley Company (sheet 1)	64	Aug.	P 728.101.

WEIGHT PER FOOT OF THREADED AND COUPLED LINE PIPE (Based on A.P.I. Formulas)

Length of threaded pipe with coupling, ft. and in.	Nominal pipe size													
	⅛-in.	¼-in.	⅜-in.	½-in.	¾-in.	1-in.	1¼-in.	1½-in.	2-in.	2½-in.	3-in.	3½-in.	4-in.	5-in.
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— 3	.2499	.4299	.5700	.8599	1.1399	1.6998	2.9996	2.7495	3.7488	5.9886	7.6985	9.2484	10.997	14.995
— 4	.2499	.4299	.5700	.8599	1.1399	1.6997	2.9995	2.7494	3.7484	5.9882	7.6980	9.2478	10.996	14.994
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— 9	.2498	.4298	.5699	.8597	1.1397	1.6993	2.2900	2.7488	3.7465	5.8964	7.6955	9.2449	10.993	14.986
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— 2	.2497	.4297	.5698	.8594	1.1394	1.6989	2.2984	2.7481	3.7445	5.8940	7.6932	9.2423	10.989	14.979
— 3	.2496	.4296	.5698	.8594	1.1394	1.6988	2.2983	2.7480	3.7442	5.8937	7.6927	9.2417	10.988	14.977
— 4	.2496	.4296	.5698	.8594	1.1394	1.6987	2.2982	2.7479	3.7438	5.8933	7.6922	9.2411	10.987	14.976
— 5	.2496	.4296	.5698	.8593	1.1393	1.6986	2.2981	2.7478	3.7435	5.8930	7.6917	9.2405	10.986	14.974
21— 6	0.2496	0.4296	0.5698	0.8593	1.1393	1.6985	2.2980	2.7477	3.7432	5.8926	7.6912	9.2400	10.986	14.973
— 7	.2496	.4296	.5698	.8593	1.1393	1.6985	2.2979	2.7475	3.7429	5.8922	7.6907	9.2395	10.985	14.971
— 8	.2495	.4295	.5697	.8592	1.1392	1.6984	2.2979	2.7474	3.7425	5.8919	7.6902	9.2390	10.984	14.970
— 9	.2495	.4295	.5697	.8592	1.1392	1.6983	2.2978	2.7473	3.7422	5.8915	7.6898	9.2386	10.983	14.968
—10	.2495	.4295	.5697	.8592	1.1392	1.6982	2.2977	2.7472	3.7418	5.8911	7.6894	9.2382	10.983	14.967
—11	.2495	.4295	.5697	.8591	1.1391	1.6981	2.2976	2.7471	3.7415	5.8908	7.6890	9.2377	10.982	14.966
22— 0	0.2495	0.4295	0.5697	0.8591	1.1391	1.6980	2.2975	2.7470	3.7411	5.8905	7.6886	9.2373	10.981	14.965

Values based on formulas adopted by A.P.I., November, 1938. See paragraph 12-C, Supplement No. 5 (April, 1939) to the Sixth Edition of A.P.I. No. 5-L "Line Pipe."

Everybody likes these handy Larkin cartons!

LARKIN SWAGED NIPPLES AND BULL PLUGS

GUARANTEE THESE 6 ADVANTAGES:

- Larkin Seamless Bull Plugs are pressed from NEW flat strip steel, cupped and drawn into plugs which have neither seams nor welds at side or end.
- Larkin Seamless Swaged Nipples are forged from NEW Seamless full-weight pipe or casing.
- Uniform length, shape and outline . . . ends faced square . . . perfect threads, beveled for easy starting . . . inside edges chamfered . . . rigid inspection.
- Dependable and Leakproof! . . . Larkin fittings are actually stronger than the lines on which they are used.
- Sufficient length to allow ample room for pipe tongs.
- Label shows plainly the size and thread, for convenience of field men and warehouse men.

In sizes one inch and smaller, you can get Larkin Plugs and Nipples, at no extra cost, in the new Hexagonal Shape, permitting the use of an adjustable or open end wrench.

LARKIN PACKER COMPANY, INC., ST. LOUIS, U.S.A.
Export Office: 30 Rockefeller Plaza, New York

LARKIN PACKER CO.

VOLUME OF LIQUID CONTAINED IN DRILL-PIPE STRINGS, BBL.

Nominal diam. → / I.D., inches →	2⅜-in. 1.815	2⅜-in. 2.000	2⅞-in. 2.151	2⅞-in. 2.323	2⅞-in. 2.469	3½-in. 2.764	3½-in. 2.900	3½-in. 3.063	4½-in. 3.826	4½-in. 3.958	4½-in. 4.000	5⅝-in. 4.733	5⅝-in. 4.859	5⅝-in. 4.975	6⅝-in. 5.761	6⅝-in. 5.965	6⅝-in. 6.065	7⅝-in.† 6.969	8⅝-in.† 7.825
Length of drill-pipe, ft.																			
1	.....	.....	.....	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.06
2	.....	.....	.....	.01	.01	.01	.02	.02	.03	.03	.03	.04	.05	.05	.06	.07	.07	.09	.12
3	.....	.....	.....	.02	.02	.02	.02	.03	.04	.05	.05	.07	.07	.07	.10	.10	.11	.14	.18
4	.....	.....	.....	.03	.02	.03	.03	.04	.06	.06	.06	.09	.09	.10	.13	.14	.14	.19	.24
5	.....	.....	.....	.03	.03	.04	.04	.05	.07	.08	.08	.11	.11	.12	.16	.17	.18	.24	.30
6	.....	.....	.....	.03	.04	.04	.05	.05	.09	.09	.09	.13	.14	.14	.19	.21	.21	.28	.36
7	.....	.....	.....	.04	.04	.05	.06	.06	.10	.11	.11	.15	.16	.17	.23	.24	.25	.33	.42
8	.....	.....	.....	.04	.05	.06	.07	.07	.11	.12	.12	.17	.18	.19	.26	.28	.29	.38	.48
9	.....	.....	.....	.05	.05	.07	.07	.08	.13	.14	.14	.20	.21	.22	.29	.31	.32	.42	.53
10	0.03	0.03	0.04	.05	.06	.07	.08	.09	.14	.15	.16	.22	.23	.24	.32	.35	.36	.47	.59
20	.06	.08	.09	.10	.12	.15	.16	.18	.28	.30	.31	.43	.46	.48	.64	.69	.71	.94	1.19
30	.10	.12	.13	.16	.18	.22	.24	.27	.43	.46	.47	.65	.69	.72	.97	1.04	1.07	1.41	1.78
40	.13	.16	.18	.21	.24	.30	.33	.36	.57	.61	.62	.87	.92	.96	1.29	1.38	1.43	1.89	2.38
50	.16	.19	.22	.26	.30	.37	.41	.46	.71	.76	.78	1.09	1.15	1.20	1.61	1.73	1.79	2.36	2.97
60	.19	.23	.27	.31	.36	.44	.49	.55	.85	.91	.93	1.30	1.38	1.44	1.93	2.07	2.14	2.83	3.57
70	.22	.27	.31	.37	.41	.52	.57	.64	.99	1.07	1.09	1.52	1.60	1.68	2.26	2.42	2.50	3.30	4.16
80	.26	.31	.36	.42	.47	.59	.65	.73	1.14	1.22	1.24	1.74	1.83	1.92	2.58	2.76	2.86	3.77	4.76
90	.29	.35	.40	.47	.53	.67	.73	.82	1.28	1.37	1.40	1.96	2.06	2.16	2.90	3.11	3.21	4.24	5.35
100	.32	.39	.45	.52	.59	.74	.82	.91	1.42	1.52	1.55	2.17	2.29	2.40	3.22	3.45	3.57	4.72	5.94
200	.64	.77	.90	1.05	1.18	1.48	1.63	1.82	2.84	3.04	3.11	4.35	4.58	4.81	6.44	6.91	7.14	9.43	11.89
300	.96	1.17	1.35	1.57	1.78	2.22	2.45	2.73	4.26	4.57	4.66	6.52	6.88	7.21	9.67	10.36	10.71	14.15	17.83
400	1.28	1.55	1.80	2.10	2.37	2.97	3.27	3.64	5.68	6.09	6.22	8.70	9.17	9.61	12.89	13.82	14 28	18.86	23.78
500	1.60	1.94	2.25	2.62	2.96	3.71	4.08	4.55	7.11	7.61	7.77	10.87	11.46	12.02	16.11	17.27	17.86	23.58	29.72
600	1.92	2.33	2.70	3.15	3.55	4.45	4.90	5.47	8.53	9.13	9.32	13.04	13.75	14.42	19.33	20.72	21.43	28.30	35.66
700	2.24	2.72	3.15	3.67	4.14	5.19	5.71	6.38	9.95	10.65	10.88	15.22	16.04	16.82	22.55	24.18	25.00	33.01	41.61
800	2.56	3.11	3.60	4.19	4.73	5.93	6.53	7.29	11.37	12.18	12.43	17.39	18.34	19.22	25.78	27.63	28.57	37.73	47.55
900	2.88	3.50	4.05	4.72	5.33	6.67	7.35	8.20	12.79	13.70	13.99	19.57	20.63	21.63	29.00	31.09	32.14	42.44	53.50
1,000	3.20	3.89	4.50	5.24	5.92	7.42	8.16	9.11	14.21	15.22	15.54	21.74	22.92	24.03	32.22	34.54	35.71	47.16	59.44
2,000	6.40	7.77	8.99	10.48	11.84	14.83	16.33	18.22	28.42	30.44	31.08	43.48	45.84	48.06	64.44	69.08	71.42	94.32	118.9
3,000	9.60	11.66	13.49	15.73	17.75	22.25	24.49	27.33	42.63	45.66	46.62	65.22	68.76	72.09	96.66	103.6	107.1	141.5	178.3
4,000	12.80	15.54	17.98	20.97	23.67	29.66	32.66	36.44	56.84	60.88	62.16	86.96	91.68	96.12	128.9	138.2	142.8	188.6	237.8
5,000	16.00	19.43	22.48	26.21	29.59	37.08	40.82	45.55	71.05	76.10	77.70	108.7	114.6	120.2	161.1	172.7	178.6	235.8	297.2
6,000	19.20	23.32	26.97	31.45	35.51	44.50	48.98	54.65	85.26	91.32	93.24	130.4	137.5	144.2	193.3	207.2	214.3	283.0	356.6
7,000	22.40	27.20	31.47	36.69	41.43	51.91	57.15	63.76	99.47	106.5	108.8	152.2	160.4	168.2	225.5	241.8	250.0	330.1	416.1
8,000	25.60	31.09	35.96	41.94	47.34	59.33	65.31	72.87	113.7	121.8	124.3	173.9	183.4	192.2	257.8	276.3	285.7	377.3	475.5
9,000	28.80	34.97	40.46	47.18	53.26	66.74	73.48	81.98	127.9	137.0	139.9	195.7	206.3	216.3	290.0	310.9	321.4	424.4	535.0
10,000	32.00	38.86	44.95	52.42	59.18	74.16	81.64	91.09	142.1	152.2	155.4	217.4	229.2	240.3	322.2	345.4	357.1	471.6	594.4

Example: In a drill-stem test, the 3½-in. drill string fills with oil from 11,285 ft. to 8462 ft. in 4 hr. What is the rate of fill-up in bbl. per hr?

Solution: 11,285 — 8,462 = 2823 ft.

From table:
2000 ft. of 3½-in. drill-pipe contains 16.33 bbl.
800 ft. of 3½-in. drill-pipe contains 6.53 bbl.
20 ft. of 3½-in. drill-pipe contains .16 bbl.
3 ft. of 3½-in. drill-pipe contains .02 bbl.
23.04 bbl.

Therefore, rate of fill-up is 5.76 bbl. per hr.

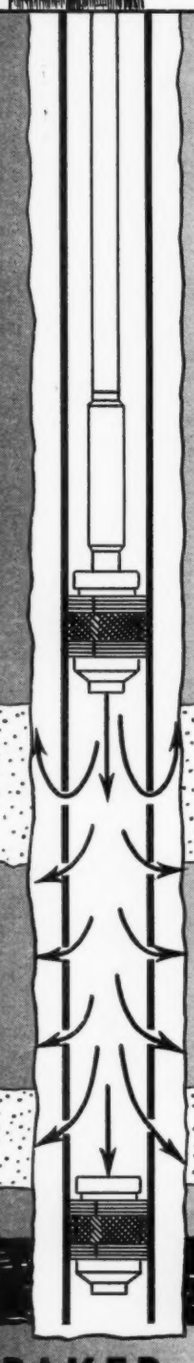
Note: I.D. of drill-pipe is 2.900 in.

†Tentative sizes; available on special order only.

WATER EXCLUSION

BY SQUEEZE CEMENTING

A RESULT THAT THE BAKER CEMENT RETAINER IS ACCOMPLISHING FOR OPERATORS DAILY



BAKER CEMENT RETAINER APPLICATIONS INCLUDE:

SQUEEZE JOBS

RE-CEMENTING

CEMENTING BEHIND SECTIONS OF PIPE

REDUCING GAS/OIL RATIOS

SERIES CEMENTING

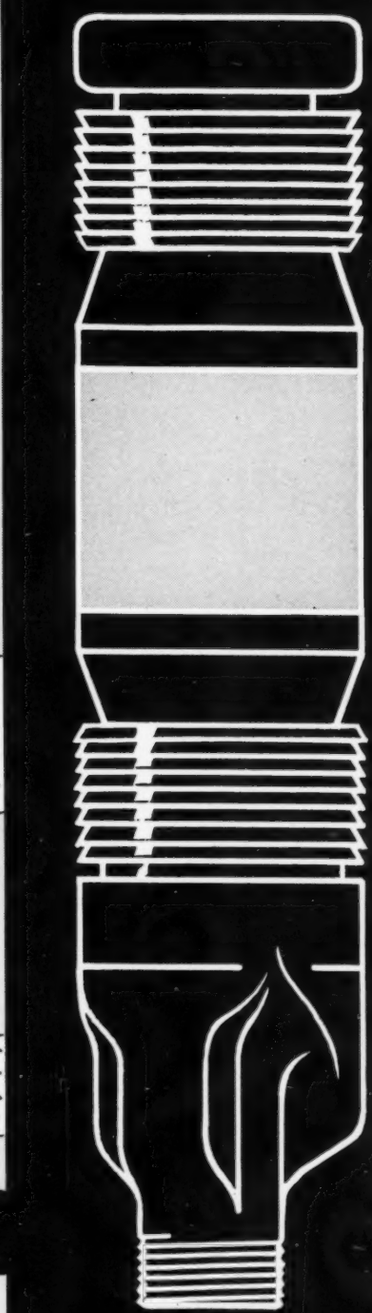
PLUGGING OFF BOTTOM FLUIDS

PLUGGING BACK TO UPPER ZONES

TESTING UPPER CASED FORMATIONS

AS A HEAVING PLUG

AS BRIDGE PLUG



Send for Broadcast No. 17-A, giving complete details concerning this remarkable tool.

BAKER OIL TOOLS, INC.

HUNTINGTON PARK, CALIFORNIA
HOUSTON, TEXAS

BAKER CEMENT RETAINER

NET WEIGHT OF 2⅞-IN. DRILL PIPE IN ROTARY MUD, LB.

Length of string of drill pipe ft.	6.45 lb. drill pipe				8.35 lb. drill pipe				10.4 lb. drill pipe			
	Weight of fluid				Weight of fluid				Weight of fluid			
	12.0 lb. per gal.	13.4 lb. per gal.	14.7 lb. per gal.	16.0 lb. per gal.	12.0 lb. per gal.	13.4 lb. per gal.	14.7 lb. per gal.	16.0 lb. per gal.	12.0 lb. per gal.	13.4 lb. per gal.	14.7 lb. per gal.	16.0 lb. per gal.
	90 lb. per cu. ft.	100 lb. per cu. ft.	110 lb. per cu. ft.	120 lb. per cu. ft.	90 lb. per cu. ft.	100 lb. per cu. ft.	110 lb. per cu. ft.	120 lb. per cu. ft.	90 lb. per cu. ft.	100 lb. per cu. ft.	110 lb. per cu. ft.	120 lb. per cu. ft.
2,000	10,695	10,440	10,200	9,960	13,890	13,560	13,260	12,950	17,235	16,820	16,435	16,050
2,200	11,765	11,485	11,220	10,960	15,280	14,920	14,585	14,245	18,960	18,500	18,075	17,655
2,400	12,835	12,530	12,240	11,955	16,670	16,275	15,910	15,540	20,685	20,185	19,720	19,260
2,600	13,905	13,570	13,265	12,950	18,060	17,630	17,235	16,840	22,405	21,865	21,365	20,860
2,800	14,975	14,615	14,285	13,945	19,450	18,990	18,560	18,135	24,130	23,550	23,010	22,465
3,000	16,045	15,660	15,305	14,945	20,835	20,345	19,885	19,430	25,855	25,230	24,650	24,070
3,200	17,115	16,705	16,325	15,940	22,225	21,700	21,215	20,725	27,580	26,910	26,295	25,675
3,400	18,185	17,750	17,345	16,935	23,615	23,060	22,540	22,020	29,300	28,595	27,940	27,280
3,600	19,255	18,790	18,365	17,930	25,000	24,410	23,865	23,315	31,025	30,275	29,580	28,885
3,800	20,320	19,835	19,385	18,930	26,390	25,770	25,190	24,610	32,750	31,960	31,225	30,490
4,000	21,390	20,880	20,405	19,925	27,780	27,125	26,515	25,905	34,470	33,640	32,870	32,095
4,200	22,460	21,925	21,425	20,920	29,170	28,480	27,840	27,200	36,195	35,320	34,510	33,700
4,400	23,530	22,970	22,445	21,915	30,560	29,840	29,170	28,495	37,920	37,005	36,155	35,305
4,600	24,600	24,010	23,465	22,915	31,950	31,190	30,495	29,790	39,645	38,685	37,800	36,910
4,800	25,670	25,055	24,485	23,910	33,335	32,550	31,820	31,085	41,365	40,370	39,440	38,515
5,000	26,740	26,100	25,505	24,905	34,725	33,905	33,145	32,380	43,090	42 050	41 085	40,120
5,200	27,810	27,145	26,525	25,900	36,115	35,260	34,470	33,675	44,815	43,730	42,730	41,725
5,400	28,880	28,190	27,545	26,895	37,505	36,615	35,795	34,970	46,535	45,415	44,370	43,330
5,600	29,950	29,230	28,565	27,895	38,890	37,975	37,120	36,265	48,260	47,095	46,015	44,935
5,800	31,020	30,275	29,585	28,890	40,280	39,330	38,450	37,560	49,985	48,780	47,660	46,540
6,000	32,090	31,320	30,605	29,885	41,670	40,685	39,775	38,855	51,710	50,460	49,300	48,145
6,200	33,160	32,365	31,625	30,880	43,060	42,040	41,100	40,150	53,430	52,140	50,945	49,750
6,400	34,225	33,410	32,645	31,880	44,450	43,400	42,425	41,445	55,155	53,825	52,590	51,355
6,600	35,295	34,450	33,665	32,875	45,840	44,755	43,750	42,740	56,880	55,505	54,230	52,960
6,800	36,365	35,495	34,685	33,870	47,230	46,110	45,075	44,035	58,600	57,190	55,875	54,565
7,000	37,435	36,540	35,705	34,865	48,615	47,465	46,405	45,330	60,325	58,870	57,520	56,170
7,200	38,505	37,585	36,725	35,865	50,005	48,825	47,730	46,625	62,050	60,550	59,160	57,775
7,400	39,575	38,630	37,745	36,860	51,395	50,180	49,055	47,920	63,775	62,235	60,805	59,380
7,600	40,645	39,670	38,770	37,855	52,780	51,535	50,380	49,220	65,495	63,915	62,450	60,980
7,800	41,715	40,715	39,790	38,850	54,160	52,890	51,705	50,515	67,220	65,600	64,095	62,585
8,000	42,785	41,760	40,810	39,850	55,560	54,250	53,030	51,810	68,945	67,280	65,735	64,190
8,200	43,855	42,805	41,830	40,845	56,950	55,605	54,360	53,105	70,670	68,960	67,380	65,795
8,400	44,925	43,850	42,850	41,840	58,340	56,960	55,685	54,400	72,390	70,645	69,025	67,400
8,600	45,995	44,890	43,870	42,835	59,730	58,315	57,010	55,695	74,115	72,325	70,665	69,005
8,800	47,060	45,935	44,890	43,835	61,120	59,670	58,335	56,990	75,840	74,010	72,310	70,610
9,000	48,130	46,980	45,910	44,830	62,505	61,030	59,660	58,285	77,560	75,690	73,955	72,215
9,200	49,200	48,025	46,930	45,825	63,895	62,385	60,985	59,580	79,285	77,370	75,595	73,820
9,400	50,270	49,070	47,950	46,820	65,285	63,740	62,315	60,875	81,010	79,055	77,240	75,425
9,600	51,340	50,110	48,970	47,820	66,670	65,100	63,640	62,170	82,735	80,735	78,880	77,030
9,800	52,410	51,155	49,990	48,815	68,060	66,455	64,965	63,465	84,455	82,420	80,525	78,635
10,000	53,480	52,200	51,010	49,810	69,450	67,810	66,290	64,760	86,180	84,100	82,170	80,240
10,200	54,550	53,245	52,030	50,805	70,840	69,165	67,615	66,055	87,905	85,780	83,815	81,845
10,400	55,620	54,290	53,050	51,800	72,230	70,520	68,940	67,350	89,625	87,465	85,455	83,450
10,600	56,690	55,330	54,070	52,800	73,615	71,880	70,265	68,645	91,350	89,145	87,100	85,055
10,800	57,760	56,375	55,090	53,795	75,005	73,235	71,595	69,940	93,075	90,830	88,745	86,660
11,000	58,830	57,420	56,110	54,790	76,395	74,590	72,920	71,235	94,800	92,510	90,385	88,265
11,200	59,900	58,465	57,130	55,785	77,785	75,945	74,245	72,530	96,520	94,190	92,030	89,870
11,400	60,965	59,510	58,150	56,785	79,175	77,305	75,570	73,825	98,245	95,875	93,675	91,475
11,600	62,035	60,550	59,170	57,780	80,560	78,660	76,895	75,120	99,970	97,555	95,315	93,080
11,800	63,105	61,595	60,190	58,775	81,950	80,015	78,220	76,415	101,700	99,240	96,960	94,685
12,000	64,175	62,640	61,210	59,770	83,340	81,370	79,550	77,710	103,400	100,900	98,605	96,290
12,200	65,245	63,685	62,230	60,770	84,730	82,730	80,875	79,005	105,150	102,600	100,250	97,895
12,400	66,315	64,730	63,250	61,765	86,120	84,085	82,200	80,300	106,850	104,300	101,900	99,500
12,600	67,385	65,770	64,275	62,760	87,510	85,440	83,525	81,600	108,600	105,950	103,550	101,100
12,800	68,455	66,815	65,295	63,755	88,895	86,795	84,850	82,895	110,300	107,650	105,180	102,700
13,000	69,525	67,860	66,315	64,755	90,285	88,155	86,175	84,190	112,050	109,350	106,800	104,300

NOTE: For other data pertaining to weight and volume of 2⅞-in. drill pipe, see table P 425.240.287.

START DRILLING IN 6 HOURS

After Equipment Arrives on Location, with this BREWSTER CR-200 RIG

This Brewster Rig incorporates several unique features that allow it to be made far more compact than the average so-called portable rig.

The entire drilling rig is made up of two units.

One unit consists of Engine, Oilbath Transmission, Draw Works and Oilbath Rotary, all mounted on a one-piece all-welded skid-type base.

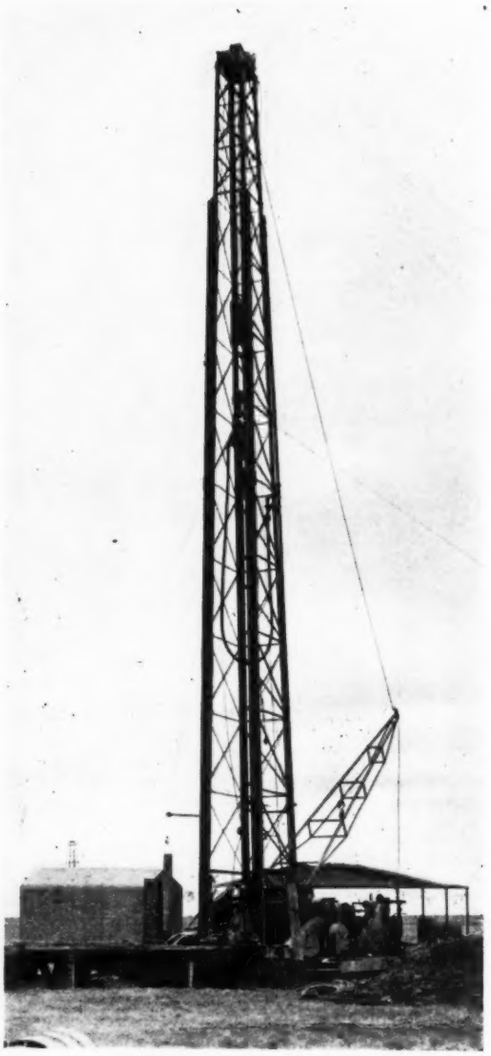
The other unit comprises Pump and Pump Engine, also mounted on a skid-type base.

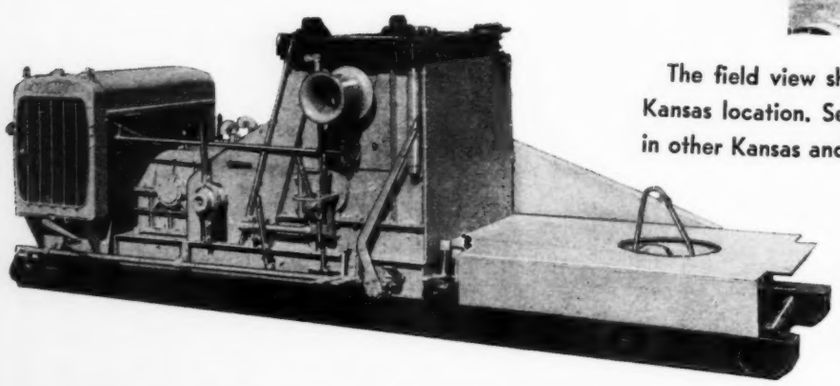
On location, these two units are bolted together so that both engines can be compounded, giving additional power for draw works or pump when this reserve power becomes necessary.

The 4-speed oilbath transmission employed is of exclusive Brewster design and can be seen between the engine and draw works in the illustration below.

Likewise, the 18" oilbath-rotary is of exclusive Brewster design. The table turns on ball bearings running in a bath of oil. The table gear and pinion gear are machine cut and run in a separate oil bath. The pinion shaft has roller bearings, Alemite lubricated.

The derrick is one-piece mast type, quickly and easily raised to position by the gin pole shown suspended over the motors and pump. This gin pole is furnished as standard equipment.





The field view shows a Model CR-200 Brewster Rig on a Kansas location. Several such Brewster rigs are now drilling in other Kansas and Illinois fields.

We will be glad to send you full particulars about this Brewster Rig, or if you will let us have your drilling requirements we will quote on a drilling rig made to fit your exact needs.

THE BREWSTER CO., INC.

Phone 2-3181 **Shreveport, La.**

NEW IBERIA HOUMA LAKE CHARLES RODESSA BUNKIE

Export Office: Acme Well Supply Company, 136 Liberty Street, New York City

VOLUME OF LIQUID CONTAINED IN CASING STRINGS, BBL.

Nominal diam. → / I.D., inches →	8⅝-in.† 7.651	8⅝-in.† 7.775	8⅝-in.† 7.825	8⅝-in.† 7.921	8⅝-in.† 8.017	9-in.† 8.032	9-in.† 8.150	9-in.† 8.196	9-in.† 8.290	9⅝-in.† 8.755	9⅝-in.† 8.835	9⅝-in.† 8.921	10¾-in. 9.760	10-¾in. 9.850	10¾-in. 9.950	10¾-in. 10.050	11¾-in.† 10.772	11¾-in.† 10.880	11¾-in.† 11.000	13⅜-in. 12.415	13⅜-in. 12.515	13⅜-in. 12.615	13⅜-in. 12.715
Length of casing, ft.																							
1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.15	0.15	0.15	0.16
2	.11	.12	.12	.12	.12	.13	.13	.13	.13	.15	.15	.15	.19	.19	.19	.20	.23	.23	.24	.30	.30	.31	.31
3	.17	.18	.18	.18	.19	.19	.19	.20	.20	.22	.23	.23	.28	.28	.29	.29	.34	.35	.35	.45	.46	.46	.47
4	.23	.23	.24	.24	.25	.25	.26	.26	.27	.30	.30	.31	.37	.38	.38	.39	.45	.46	.47	.60	.61	.62	.63
5	.28	.29	.30	.30	.31	.31	.32	.33	.33	.37	.38	.39	.46	.47	.48	.49	.56	.58	.59	.75	.76	.77	.79
6	.34	.35	.36	.37	.37	.38	.39	.39	.40	.45	.46	.46	.56	.57	.58	.59	.68	.69	.71	.90	.91	.93	.94
7	.40	.41	.42	.43	.44	.44	.45	.46	.47	.52	.53	.54	.65	.66	.67	.69	.79	.81	.82	1.05	1.07	1.08	1.10
8	.45	.47	.48	.49	.50	.50	.52	.52	.53	.60	.61	.62	.74	.75	.77	.79	.90	.92	.94	1.20	1.22	1.24	1.26
9	.51	.53	.54	.55	.56	.56	.58	.59	.60	.67	.68	.70	.83	.85	.87	.88	1.01	1.03	1.06	1.35	1.37	1.39	1.41
10	0.57	0.59	0.59	0.61	0.62	0.63	0.65	0.65	0.67	0.74	0.76	0.77	0.93	0.94	0.96	0.98	1.13	1.15	1.17	1.50	1.52	1.55	1.57
20	1.14	1.17	1.19	1.22	1.25	1.25	1.29	1.31	1.34	1.49	1.52	1.55	1.85	1.88	1.92	1.96	2.25	2.30	2.35	2.99	3.04	3.09	3.14
30	1.71	1.76	1.78	1.83	1.87	1.88	1.94	1.96	2.00	2.23	2.27	2.32	2.78	2.83	2.88	2.94	3.38	3.45	3.53	4.49	4.56	4.64	4.71
40	2.27	2.35	2.38	2.44	2.50	2.51	2.58	2.61	2.67	2.98	3.03	3.09	3.70	3.77	3.85	3.92	4.51	4.60	4.70	5.99	6.08	6.18	6.28
50	2.84	2.94	2.97	3.05	3.12	3.13	3.23	3.26	3.34	3.72	3.79	3.86	4.63	4.71	4.81	4.90	5.63	5.75	5.88	7.48	7.60	7.73	7.85
60	3.41	3.52	3.57	3.66	3.74	3.76	3.87	3.91	4.00	4.47	4.55	4.64	5.55	5.65	5.77	5.88	6.76	6.90	7.05	8.98	9.13	9.27	9.42
70	3.98	4.11	4.16	4.26	4.37	4.38	4.52	4.57	4.67	5.21	5.31	5.41	6.48	6.60	6.73	6.87	7.89	8.05	8.22	10.48	10.65	10.82	10.99
80	4.55	4.70	4.76	4.87	4.99	5.01	5.16	5.22	5.34	5.95	6.06	6.18	7.40	7.54	7.69	7.85	9.01	9.20	9.40	11.97	12.17	12.36	12.56
90	5.12	5.28	5.35	5.48	5.62	5.64	5.81	5.87	6.01	6.70	6.82	6.96	8.33	8.48	8.65	8.83	10.14	10.34	10.57	13.47	13.69	13.91	14.13
100	5.68	5.87	5.95	6.09	6.24	6.26	6.45	6.52	6.67	7.44	7.58	7.73	9.25	9.42	9.61	9.81	11.27	11.49	11.75	14.97	15.21	15.45	15.70
200	11.37	11.74	11.89	12.18	12.48	12.53	12.90	13.05	13.35	14.89	15.16	15.46	18.50	18.84	19.23	19.61	22.53	22.99	23.50	29.93	30.42	30.90	31.40
300	17.05	17.61	17.84	18.28	18.72	18.79	19.35	19.57	20.02	22.33	22.74	23.18	27.75	28.26	28.84	29.42	33.80	34.48	35.25	44.90	45.62	46.36	47.09
400	22.74	23.48	23.78	24.37	24.96	25.06	25.80	26.09	26.69	29.77	30.32	30.91	37.00	37.68	38.45	39.23	45.07	45.98	47.00	59.86	60.83	61.81	62.79
500	28.42	29.35	29.73	30.46	31.21	31.32	32.25	32.62	33.37	37.22	37.90	38.64	46.25	47.11	48.07	49.04	56.34	57.47	58.75	74.83	76.04	77.26	78.49
600	34.10	35.22	35.67	36.55	37.45	37.58	38.70	39.14	40.04	44.66	45.47	46.37	55.50	56.53	57.68	58.84	67.60	68.96	70.49	89.80	91.25	92.71	94.19
700	39.79	41.09	41.62	42.64	43.69	43.85	45.15	45.66	46.71	52.10	53.05	54.10	64.75	65.95	67.29	68.65	78.87	80.46	82.24	104.8	106.5	108.2	109.9
800	45.47	46.96	47.56	48.74	49.93	50.11	51.60	52.18	53.38	59.54	60.63	61.82	74.00	75.37	76.90	78.46	90.14	91.95	93.99	119.7	121.7	123.6	125.6
900	51.16	52.83	53.51	54.83	56.17	56.38	58.05	58.71	60.06	66.99	68.21	69.55	83.25	84.79	86.52	88.26	101.4	103.4	105.7	134.7	136.9	139.1	141.3
1,000	56.84	58.70	59.45	60.92	62.41	62.64	64.50	65.23	66.73	74.43	75.79	77.28	92.50	94.21	96.13	98.07	112.7	114.9	117.5	149.7	152.1	154.5	157.0
2,000	113.7	117.4	118.9	121.8	124.8	125.3	129.0	130.5	133.5	148.9	151.6	154.6	185.0	188.4	192.3	196.1	225.3	229.9	235.0	299.3	304.2	309.0	314.0
3,000	170.5	176.1	178.4	182.8	187.2	187.9	193.5	195.7	200.2	223.3	227.4	231.8	277.5	282.6	288.4	294.2	338.0	344.8	352.5	449.0	456.2	463.6	470.9
4,000	227.4	234.8	237.8	243.7	249.6	250.6	258.0	260.9	266.9	297.7	303.2	309.1	370.0	376.8	384.5	392.3	450.7	459.8	470.0	598.6	608.3	618.1	627.9
5,000	284.2	293.5	297.3	304.6	312.1	313.2	322.5	326.2	333.7	372.2	379.0	386.4	462.5	471.1	480.7	490.4	563.4	574.7	587.5	748.3	760.4	772.6	784.9
6,000	341.0	352.2	356.7	365.5	374.5	375.8	387.0	391.4	400.4	446.6	454.7	463.7	550.0	565.3	576.8	588.4	676.0	689.6	704.9	898.0	912.5	927.1	941.9
7,000	397.9	410.9	416.2	426.4	436.9	438.5	451.5	456.6	467.1	521.0	530.5	541.0	647.5	659.5	672.9	686.5	788.7	804.6	822.4	1048.	1065.	1082.	1099.
8,000	454.7	469.6	475.6	487.4	499.3	501.1	516.0	521.8	533.8	595.4	603.3	618.2	740.0	753.7	769.0	784.6	901.4	919.5	939.9	1197.	1217.	1236.	1256.
9,000	511.6	528.3	535.1	548.3	561.7	563.8	580.5	587.1	600.6	669.9	682.1	695.5	832.5	847.9	865.2	882.6	1014.	1034.	1057.	1347.	1369.	1391.	1413.
10,000	568.4	587.0	594.5	609.2	624.1	626.4	645.0	652.3	667.3	744.3	757.9	772.8	925.0	942.1	961.3	980.7	1127.	1149.	1175.	1497.	1521.	1545.	1570.

Example: After balling-down a well to 10895 ft., the 8⅝-in. casing string fills with oil to 7922 ft. in 6 hr. What is the rate of fill-up in bbl. per hr.?

Note: Casing I.D. is 8.017 in.

†Supplementary sizes included by A.P.I. on request of certain districts.

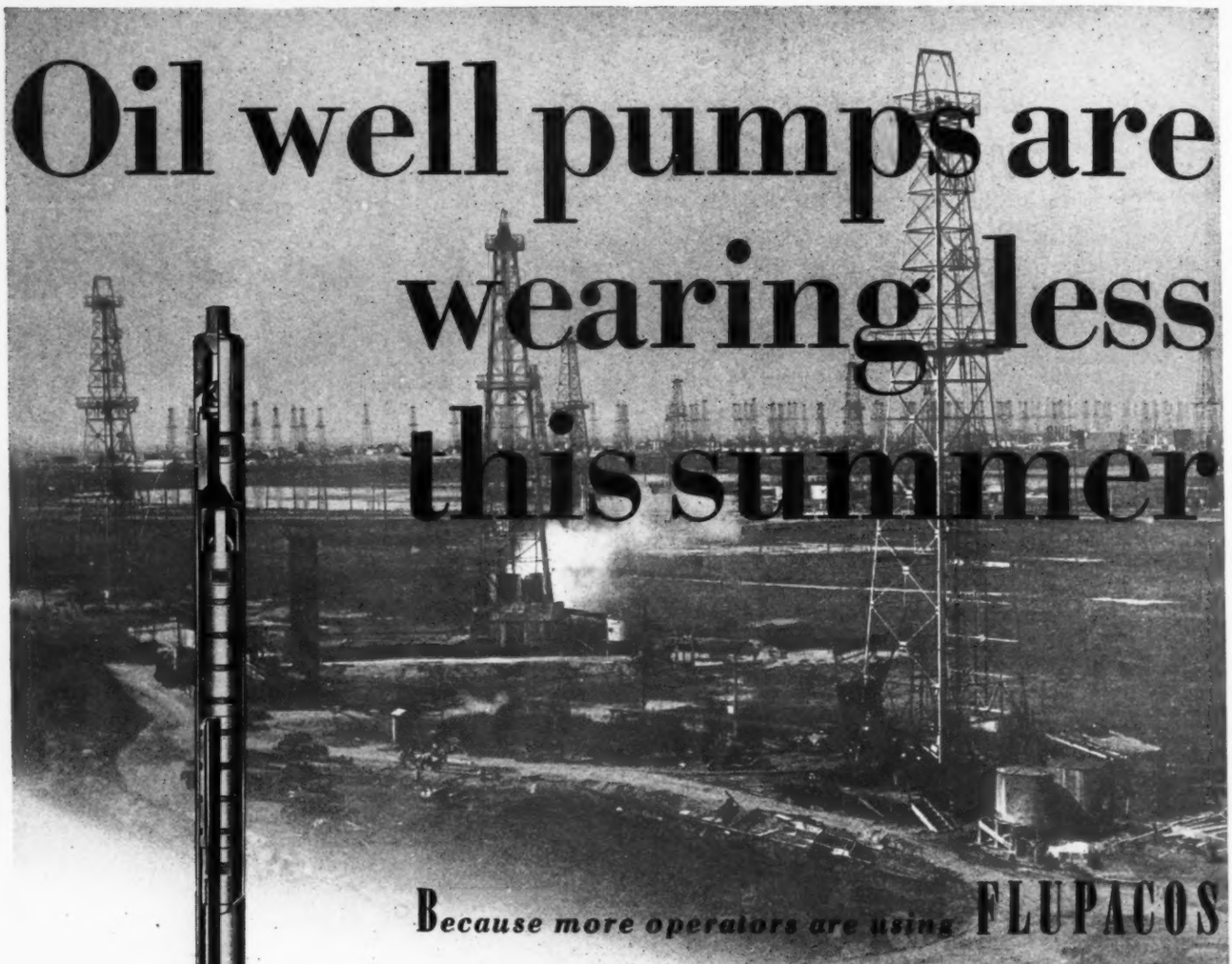
Solution: 10895 — 7922 = 2973

From table:

2000 ft. of casing contains	124.8 bbl.
900 ft. of casing contains	56.17 bbl.
70 ft. of casing contains	4.37 bbl.
3 ft. of casing contains	.19 bbl.
	185.53 bbl.

Therefore, rate of fill-up is 30.92 bbl. per hr.

Oil well pumps are wearing less this summer



FLUPACO
GROOVE SEAL
PUMP
"PRODUCER" TYPE
Simple Construction • Long Life • Low Maintenance • Designed for Stripper Wells and Wells of Medium Depth and Volume

Because more operators are using FLUPACOS

★ Here's one thing you can bank your money on... With FLUPACO Groove Seal Pumps in your well it's a *long* time between "down" times, because these pumps are made *exclusively* of the finest selected materials... and are engineered, machined and assembled with the most painstaking care!

There's a FLUPACO Pump for every condition. For example, the FLUPACO Groove Seal "Producer," illustrated at left, is an insert pump offering the greatest economy in pumping stripper wells and wells of medium depth and volume. It provides the largest possible cross-sectional displacement area in this type of pump and is unusually simple in construction—which means *low maintenance costs.*

Another popular FLUPACO Pump is the "Volume Producer" which is made in longer lengths for best pumping conditions in large volume and deep wells, as well as in wells of normal volume and depth.

The complete Fluid Packed Line is shown on pages 670 to 675 of your 1939 Composite Catalog. Or write direct for full information!

FLUID PACKED PUMP CO. BOX 64, LOS NIETOS, CALIFORNIA, U.S.A.

Mid-Continent and Texas Distribution

MID-CONTINENT: FLUID PACKED PUMP CO., 2 S.E. 29th Street, Oklahoma City, Oklahoma

GULF COAST HEADQUARTERS: 2301 Congress Ave., Houston, Texas

FLANGE BOLT AND GASKET SIZES

Series 90 or 900

Nominal pipe size, in.	O.D. of pipe, in.	O.D. of flange, in.	Thickness of flange, in.	Diameter of bolt circle, in.	Number of bolts	Size of bolts			Size of flat gasket, I.D. & O.D., in.
						Diameter, in.	Machine bolt length, in.	2-nut stud length, in.	
1	1.315	For sizes 2½-in. and smaller Series 150 or 1500 should be used							
1¼	1.660								
1½	1.900								
2	2.375								
2½	2.875								
3	3.500	9½	1½	7½	8	⅞	Machine bolts are not recommended for Series 90 or 900 flanges.	6	2⅞x 6⅝
4	4.500	11½	1¾	9¼	8	1⅛		6¾	3⅞x 8⅛
6	6.625	15	2 3/16	12½	12	1⅛		7¾	5¾x11⅜
8	8.625	18½	2½	15½	12	1⅜		8¾	7½x14⅛
10	10.750	21½	2¾	18½	16	1⅜		9¼	9⅜x17⅛
12	12.750	24	3⅛	21	20	1⅜		10	11⅛x19⅝
14	14.000	25¼	3⅜	22	20	1¼		10¾	12¼x20½
16	16.000	27¾	3½	24¼	20	1⅝		11¼	14 x22⅝
18	18.000	31	4	27	20	1⅞		12¾	15¾x25⅛
20	20.000	33¾	4¼	29½	20	2		13¾	17½x27½
24	24.000	41	5½	35½	20	2½		17¼	21 x33

The above dimensions agree with the 900-lb. American Steel Flange Standard. Lengths of studs apply for male to male ¼-in. raised faces.

Series 150 or 1500

Nominal pipe size, in.	O.D. of pipe, in.	O.D. of flange, in.	Thickness of flange, in.	Diameter of bolt circle, in.	Number of bolts	Size of bolts			Size of flat gasket, I.D. & O.D., in.
						Diameter, in.	Machine bolt length, in.	2-nut stud length, in.	
1	1.315	5⅞	1⅛	4	4	⅞	Machine bolts are not recommended for Series 150 or 1500 flanges.	5	⅞x 3⅛
1¼	1.660	6¼	1⅛	4⅜	4	⅞		5	1⅛x 3½
1½	1.900	7	1¼	4⅞	4	1		5½	1⅜x 3⅞
2	2.375	8½	1½	6½	8	⅞		5¾	1⅞x 5⅛
2½	2.875	9⅝	1⅝	7½	8	1		6¼	2¼x 6½
3	3.500	10½	1⅞	8	8	1⅛		7	2¾x 6⅞
4	4.500	12¼	2⅛	9½	8	1¼		7¾	3⅝x 8¼
6	6.625	15½	3¼	12½	12	1⅜		10¼	5⅜x11⅛
8	8.625	19	3⅝	15½	12	1⅝		11½	7 x13⅞
10	10.750	23	4¼	19	12	1⅞		13¼	8¾x17⅛
12	12.750	26½	4⅞	22½	16	2		14¾	10⅜x20½
14	14.000	29½	5¼	25	16	2¼		16	11⅜x22¾
16	16.000	32½	5¾	27¾	16	2½		17½	13 x25¼
18	18.000	36	6⅜	30½	16	2¾		19¼	14⅝x27¾
20	20.000	38¾	7	32¾	16	3		21¼	16⅜x29¾
24	24.000	46	8	39	16	3½		24¼	19⅝x35½

The above dimensions agree with the 1500-lb. American Steel Flange Standard. Lengths of studs apply for male to male ¼-in. raised faces.

FOR ALL SERVICES

... Cold Water to Refining ...

Chapman Valves

offer economy of selection from standard lines to meet every requirement of the

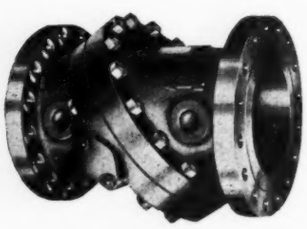
OIL AND GAS INDUSTRIES

Chapman Valves are widely used for all types of service in these industries. Fine service records, under widely varying conditions, are the best evidence of their real quality and adaptability. Standard lines embrace all types and sizes, in metals best suited for the service intended. This wide range makes selection possible at minimum cost for specific requirements. A few types are shown below as typical. Standardize on Chapman, as others are doing with economy and satisfaction.

LIST 960

FORGED STEEL GATE VALVE

Size ¼" to 2". Pressures to 800 pounds at 750 degrees F., or 1500 lbs. cold.

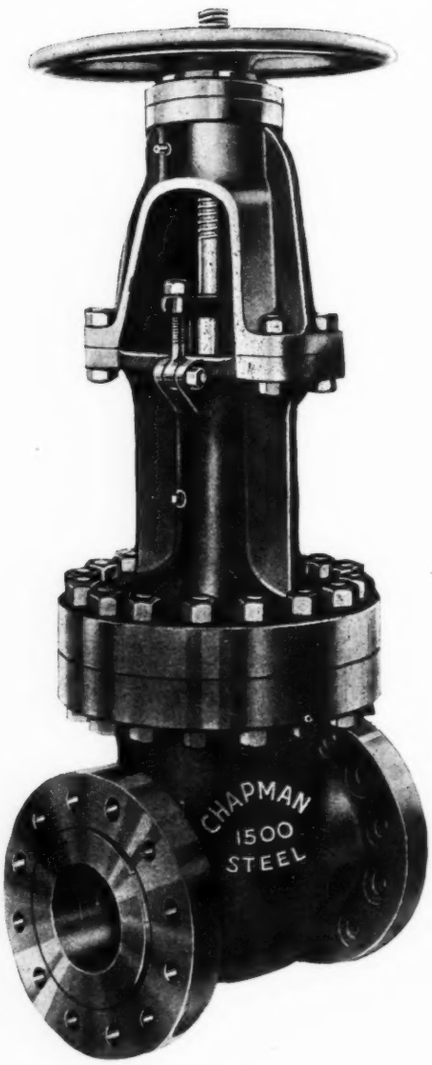


CHECK VALVE NON-SLAM TILTING DISC.

Iron, Bronze, Steel or Alloys. For pressures from 150 to 1500 lbs. Quiet; closes drop tight; reduces head loss 75%.

LIST 202

Iron Body, Bronze Mounted. Double Disc, Parallel Seat, Gate Valve. Flange or screw ends. Stationary or rising spindle. 400 lbs. pressure, O.W.G.



LIST 1500

SOLID WEDGE CAST STEEL GATE VALVE

Typical of the complete line of Chapman Steel Valves. Standardized to include all types and sizes in carbon steel or alloys best suited to meet specific conditions. Pressures to 1500 lbs. Temperatures from below zero to 1000 degrees F.

THE CHAPMAN VALVE MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.

RELATIVE HUMIDITY AND PRESSURE OF SATURATED WATER VAPOR

Wet bulb reading, deg. F.	Pressure of saturated vapor		(t—t'), difference between wet and dry bulb temperatures, deg. F.																			
	in. of Hg.	lb. per sq. in.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.03773	0.01853	68	38	12																	
1	.03975	.01963	69	41	15																	
2	.04186	.02056	70	43	19																	
3	.04409	.02166	71	46	22	1																
4	.04675	.02282	73	48	25	5																
5	0.04886	0.02400	74	50	28	9																
6	.05144	.02527	75	52	31	12																
7	.05412	.02658	76	54	34	16																
8	.05692	.02796	77	56	37	19	3															
9	.05988	.02941	78	58	39	22	7															
10	0.06295	0.03092	79	59	41	25	10															
11	.06618	.03251	79	61	44	28	14															
12	.06958	.03418	80	62	46	31	17	4														
13	.07309	.03590	81	64	48	33	20	8														
14	.07677	.03771	82	65	49	35	23	11														
15	0.08067	0.03963	82	66	51	38	25	14	4													
16	.08469	.04160	83	67	53	40	28	17	7													
17	.08895	.04369	84	68	55	42	30	20	10	1												
18	.09337	.04586	84	70	56	44	33	22	13	4												
19	.09797	.04812	85	71	58	46	35	25	16	7												
20	0.1028	0.05050	85	72	59	47	37	27	18	10	3											
21	.1078	.05295	86	72	60	49	39	29	21	13	6											
22	.1132	.05560	86	73	62	51	41	32	23	16	8	2										
23	.1186	.05826	87	74	63	52	43	34	26	18	11	5										
24	.1244	.06111	87	75	64	54	44	36	28	20	14	8	2									
25	0.1304	0.06405	87	76	65	55	46	37	30	23	16	10	5									
26	.1366	.06710	88	76	66	56	47	39	32	25	19	13	7	2								
27	.1432	.07034	88	77	67	58	49	41	34	27	21	15	10	5	1							
28	.1500	.07368	88	78	68	59	51	43	36	29	23	17	12	7	3							
29	.1571	.07717	89	78	69	60	52	45	38	31	25	20	15	10	5	1						
30	0.1645	0.08080	89	79	70	62	54	46	40	33	27	22	17	12	8	4						
31	.1722	.08458	89	80	71	63	55	48	42	35	29	24	19	14	10	6	2					
32	.1803	.08856	90	81	72	64	57	50	43	37	31	26	21	16	12	8	5	1				
33	.1879	.09230	90	81	73	65	58	51	45	39	33	28	23	18	14	10	7	3	0			
34	.1957	.09610	90	82	74	66	59	52	76	40	35	30	25	20	16	12	9	5	2			
35	0.2036	0.1000	91	83	75	67	60	54	47	42	36	31	26	22	18	14	10	7	4	1		
36	.2120	.1041	91	83	75	68	61	55	48	43	38	32	28	23	19	16	12	9	6	3	0	
37	.2205	.1083	91	83	75	69	62	55	49	44	39	34	29	25	21	17	14	10	8	5	2	
38	.2293	.1126	92	83	76	69	63	56	51	45	40	35	31	27	23	19	16	12	9	7	4	1
39	.2384	.1171	92	84	77	70	63	57	52	47	41	36	32	28	24	20	17	14	11	8	6	3
40	0.2478	0.1217	92	84	77	70	64	58	53	48	43	38	34	30	26	22	19	16	13	11	8	6
41	.2576	.1265	92	85	78	71	65	59	54	48	44	39	35	31	27	23	20	17	14	12	9	7
42	.2677	.1315	92	85	78	72	66	60	54	49	45	40	36	32	28	25	22	18	16	13	10	8
43	.2783	.1367	93	85	79	72	66	61	55	50	46	41	37	33	30	26	23	20	17	14	12	10
44	.2891	.1420	93	86	79	73	67	61	56	51	47	42	38	34	31	27	24	21	18	16	13	11
45	0.3003	0.1475	93	86	79	73	68	62	57	52	48	43	39	35	32	29	26	22	20	17	15	12
46	.3119	.1532	93	86	80	74	68	63	58	53	49	44	40	37	33	30	27	24	21	18	16	14
47	.3239	.1591	93	86	80	75	69	63	59	54	50	45	41	38	34	31	28	25	22	20	17	15
48	.3364	.1652	93	87	81	75	69	64	59	55	50	46	42	39	35	32	29	26	24	21	19	16
49	.3492	.1715	93	87	81	75	70	65	60	55	51	47	43	40	36	33	30	27	25	22	20	18
50	0.3624	0.1780	94	87	81	76	70	65	61	56	52	48	44	41	37	34	31	29	26	23	21	19
51	.3763	.1848	94	87	82	76	71	66	61	57	53	49	45	42	38	35	32	30	27	24	22	20
52	.3905	.1918	94	88	82	76	71	66	62	58	54	50	46	43	39	36	33	31	28	25	23	21
53	.4050	.1989	94	88	82	77	72	67	63	58	54	50	47	44	40	37	34	32	29	27	24	22
54	.4200	.2063	94	88	83	77	72	68	63	59	55	51	48	44	41	38	35	33	30	28	25	23
55	0.4357	0.2140	94	88	83	78	73	68	64	60	56	52	48	45	42	39	36	33	31	29	26	24
56	.4518	.2219	94	88	83	78	73	69	64	60	56	53	49	46	43	40	37	34	32	29	27	25
57	.4683	.2300	94	89	83	78	74	69	65	61	57	53	50	47	44	41	38	35	33	30	28	26
58	.4854	.2384	94	89	84	79	74	70	66	61	58	54	51	48	45	42	39	36	34	31	29	27
59	.5031	.2471	94	89	84	79	74	70	66	62	58	55	51	48	45	42	39	37	34	32	30	28

This Table is based on a barometric pressure of 30 in. Hg. Values are computed by formula:*

$$\text{Relative humidity, percent} = \frac{p' - [(B - p') \times 1.016(t - t')/(2800 - 1.3t')]}{p} \times 100$$

t = dry-bulb temperature
t' = wet-bulb temperature
p = vapor pressure corresponding to t
p' = vapor pressure corresponding to t'
B = barometric pressure
1.016 = factor to correct for mean radiation loss of sling psychrometer

NOTE: If stationary-type psychrometer is used, wet bulb should be exposed to air current having a velocity of not less than 14 ft. per sec.

*Formula developed by W. H. Carrier, *Trans. A.S.M.E.*, vol. 33, p. 1005.

†This table may be filed under P 207. if preferred.

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Also Makers of Patented MARLEY Non-Clog SPRAY NOZZLES Used in Air Conditioning and Many Industrial Services for Water Cooling, Air Washing, Brine Spraying, Ice Melting and Humidifying

HORSEPOWER LIMITATIONS OF POWER SHAFTING

Diameter[1] of shaft, in. nominal →	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞
actual →	0.500	0.625	0.750	0.875	1.000	1.125	1.250	1.375	1.500	1.625	1.750	1.875
Speed — service												
100 r.p.m.												
A	0.25- 0.31	0.48- 0.61	0.84- 1.1	1.3 - 1.7	2.0 - 2.3	2.8- 3.6	3.9- 4.9	5.2- 6.5	6.8- 8.4	8.6- 10.7	10.7- 13.4	13. - 17.
B	0.14- 0.18	0.27- 0.35	0.47- 0.60	0.74- 0.96	1.1 - 1.4	1.6- 2.0	2.2- 2.8	2.9- 3.7	3.7- 4.8	4.8- 6.1	5.9- 7.7	7.3- 7.9
C	0.10- 0.13	0.20- 0.24	0.34- 0.42	0.54- 0.67	0.80- 1.0	1.1- 1.4	1.6- 2.0	2.1- 2.6	2.7- 3.4	3.4- 4.3	4.3- 5.4	5.3- 6.6
200 r.p.m.												
A	0.50- 0.63	0.98- 1.2	1.7 - 2.1	2.7 - 3.3	4.0 - 5.0	5.7- 7.1	7.8- 9.8	10.4- 13.0	14. - 17.	17. - 21.	21. - 27	26. - 33.
B	0.28- 0.36	0.54- 0.70	0.94- 1.2	1.5 - 1.9	2.2 - 2.9	3.2- 4.1	4.3- 5.6	5.8- 7.4	7.5- 9.7	9.5- 12.	12. - 15.	15. - 19.
C	0.20- 0.25	0.39- 0.49	0.68- 0.84	1.1 - 1.3	1.6 - 2.0	2.3- 2.8	3.1- 3.9	4.2- 5.2	5.4- 6.8	6.9- 8.6	8.6- 11.	11. - 13.
300 r.p.m.												
A	0.75- 0.94	1.5 - 1.8	2.5 - 3.2	4.0 - 5.0	6.0 - 7.5	8.5- 11.	12. - 15.	16. - 20.	20. - 25.	26. - 32.	32. - 40.	40. - 49.
B	0.42- 0.54	0.81- 1.0	1.4 - 1.8	2.2 - 2.9	3.3 - 4.3	4.7- 6.1	6.5- 8.4	8.7- 11.2	11. - 14.	14. - 18.	18. - 23.	22. - 28.
C	0.30- 0.38	0.59- 0.73	1.0 - 1.3	1.6 - 2.0	2.4 - 3.0	3.4- 4.3	4.7- 5.9	6.2- 7.8	8.1- 10.	10. - 13.	13. - 16.	16. - 20.
400 r.p.m.												
A	1.0 - 1.3	2.0 - 2.4	3.4 - 4.2	5.4 - 6.7	8.0 -10.	11. - 14.	16. - 20.	21. - 26.	27. - 34.	34. - 43.	43. - 54.	53. - 66.
B	0.56- 0.71	1.1 - 1.4	1.9 - 2.4	3.0 - 3.8	4.4 - 5.7	6.3- 8.1	8.7- 11.	12 - 15	15. - 19.	19. - 25.	24. - 31.	29. - 38.
C	0.40- 0.50	0.78- 0.98	1.4 - 1.7	2.1 - 2.7	3.2 - 4.0	4.6- 5.7	6.2- 7.8	8.3- 10.4	11. - 14.	14 - 17.	17. - 21.	21. - 26.
500 r.p.m.												
A	1.3 - 1.6	2.4 - 3.1	4.2 - 5.3	6.7 - 8.4	10. -13.	14. - 18.	20. - 24.	26. - 33.	34. - 42.	43. - 54	54. - 67.	66. - 82.
B	0.70- 0.89	1.4 - 1.7	2.3 - 3.0	3.7 - 4.8	5.6 - 7.1	7.9- 10.	11. - 14.	14. - 19.	19. - 24.	24. - 31.	30. - 38.	37. - 47.
C	0.50- 0.63	0.98- 1.2	1.7 - 2.1	2.7 - 3.3	4.0 - 5.0	5.7- 7.1	7.8- 9.8	10.4- 13.0	14. - 17.	17. - 21.	21. - 27.	26. - 33.
750 r.p.m.												
A	1.9 - 2.3	3 7 - 4.6	6.3 - 7.9	10. -13.	15. -19.	21. - 27.	29. - 37.	39. - 49.	51. - 63	64. - 80.	80. -100.	99. -125.
B	1.0 - 1.3	2.0 - 2.6	3.5 - 4.5	5.6 - 7.2	8.3 -11.	12. - 15.	16. - 21.	22. - 28.	28. - 36.	36. - 46.	45. - 57.	55. - 71.
C	0.74- 0.94	1.5 - 1.8	2.5 - 3.2	4.0 - 5.0	6.0 - 7.5	8.5- 11.	12. - 15.	16. - 20.	20. - 25.	26. - 32.	32. - 40.	40. - 49.
1000 r.p.m.												
A	2.5 - 3.1	4 9 - 6.1	4.4 -11.	13. -17.	20.-25.	28. - 36.	39. - 49.	52. - 65.	68. - 84.	86. -105.	105. -135.	130. -165.
B	1.4 - 1.8	2.7 - 3.5	4.7 - 6.0	7.4 - 9.6	11.-14.	16. - 20.	22. - 28.	29. - 37.	37. - 48.	48. - 61.	59. - 77.	73. - 94.
C	1.0 - 1.3	2.0 - 2.4	3.4 - 4.2	5.4 - 6.7	8.-10.	11. - 14.	16. - 20.	21. - 26.	27. - 34.	34. - 43.	43. - 54.	53. - 66.
1250 r.p.m.												
A	3.1 - 3.9	6.1 - 7.6	11. -13.	17. -21.	25.-31.	36. - 45.	49. - 61.	65. - 81.	84. -105.	105. -135.	135. -170.	165. -205.
B	1.7 - 2.2	3.4 - 4.4	5.9 - 7.6	9.3 -12.	14.-18.	20. - 25.	27. - 35.	36. - 47.	47. - 60.	60. - 77.	75. - 95.	92. -120.
C	1.3 - 1.6	2.4 - 3.1	4.2 - 5.3	6.7 - 8.4	10.-13.	14. - 18.	20. - 24.	26. - 33.	34. - 42.	43. - 54.	54. - 67.	66. - 82.
1500 r.p.m.												
A	3.8 - 4.7	7.3 - 9.2	13. -16.	20. -25.	30.-38.	43. - 53.	59. - 73.	78. - 98.	100. -125.	130. -160.	160. -200.	200. -245.
B	2.1 - 2.7	4.1 - 5.2	7 0 - 9.0	11. -14.	17.-21.	24. - 30.	33. - 42.	43. - 56.	56. - 72.	72. - 92.	90. -115.	110. -140.
C	1.5 - 1.9	2.9 - 3.7	5.1 - 6.3	8.0 -10.	12.-15.	17. - 21.	23. - 29.	31. - 39.	41. - 51.	51. - 64.	64. - 80.	79. - 99.
1800 r.p.m.												
A	4.5 - 5 6	8.8 -11.	15. -19.	24.-30.	36.-45.	51. - 64	70. - 88.	94. -115.	120. -150.	155. -195.	195. -290.	235. -295.
B	2.5 - 3.2	4.9 - 6.3	8.4 -11.	13.-17.	20.-26.	28 - 37.	39. - 50.	52. - 67.	68. - 87.	86. -110.	105. -140.	130. -170.
C	1.8 - 2.3	3.5 - 4.4	6.1 - 7.6	10.-12.	14.-18.	21. - 26.	28. - 35.	37. - 47.	49. - 61.	62. - 77.	77. - 96.	95. -120.
2100 r.p.m.												
A	5.3 - 6.6	10. -13.	18. -22.	28.-35.	42.-53.	60. - 75.	82. -102.	110. -135.	140. -175.	180. -225.	225. -280.	275. -345.
B	2.9 - 3.8	5.7 - 7.3	9.8 -13.	16.-20.	23.-30.	33. - 43.	46. - 59.	61. - 78.	79. -100.	100. -130.	125. -160.	155. -200.
C	2.1 - 2.6	4.1 - 5.1	7.1 - 8.9	11.-14.	17.-21.	24. - 30.	33. - 41.	44. - 55.	57. - 71.	72. - 90.	90. -115.	110. -140.
2400 r.p.m.												
A	6.0 - 7.5	12. -15.	20. -25.	32.-40.	48.-60.	68. - 85.	94. -115.	125. -155.	160. -205.	205. -255.	255. -320.	315. -395.
B	3.3 - 4.3	6.5 - 8.4	11. -14.	18.-23.	27.-34.	38. - 49.	52. - 67.	69. - 89.	90. -115.	115. -145.	145. -185.	175. -225.
C	2.4 - 3.0	4.7 - 5.9	8.1 -10.	13.-16.	19.-24.	27. - 34.	37. - 47.	50. - 62.	65. - 81.	82. -105.	105. -130.	125. -160.
3000 r.p.m.												
A	7.5 - 9.4	15 -18.	25.-32.	40.-50.	60.-75.	85. -105.	115. -145.	155. -195.	205. -255.	255. -320	320. -400.	395 -495.
B	4.2 - 5.4	8 1 -10.	14.-18.	22.-29.	33.-43.	47. - 61.	65. - 84.	87. -110.	110 -145.	145. -185.	180. -230.	220. -285.
C	3.0 - 3.8	5 9 - 7 3	10.-13.	16.-20.	24.-30.	34. - 93.	47. - 59.	62. - 78.	81. -100.	105. -130.	130. -160.	160. -200.
3600 r.p.m.												
A	9.0 -11.	18. -22.	30.-38.	48.-60.	72.-90.	105. -130.	140. -175.	185. -235.	245. -305.	310. -385.	385. -480.	475. -595.
B	5.0 - 6.4	9.8 -13.	17.-22.	27.-34.	40.-51.	57. - 73.	78. -100.	105. -135.	135. -175.	170. -220.	215. -275.	265. -340.
C	3.6 - 4.5	7.0 - 8.8	12.-15.	19.-24.	29.-36.	41. - 51.	56. - 70.	75. - 94	97. -120.	125. -155.	155. -195.	190. -235.

Service symbols:

A Shafts subjected to torque only; short countershafts having pulleys or gears close to bearings.
B First receiving shafts.
C Head shafts carrying main driving pulley or gear, if well supported by bearings.

Note: The two values given in each instance do not represent limits of a range of horsepower values. The first value is the maximum h.p. recommended for turned shafting; the second value is the maximum h.p. recommended for cold-rolled shafting.

Above values apply only when bearings and loads on shaft are proportioned so that critical speed of the shaft is not exceeded.

[1]Diameters included in table are restricted to those approved by the A.P.I.

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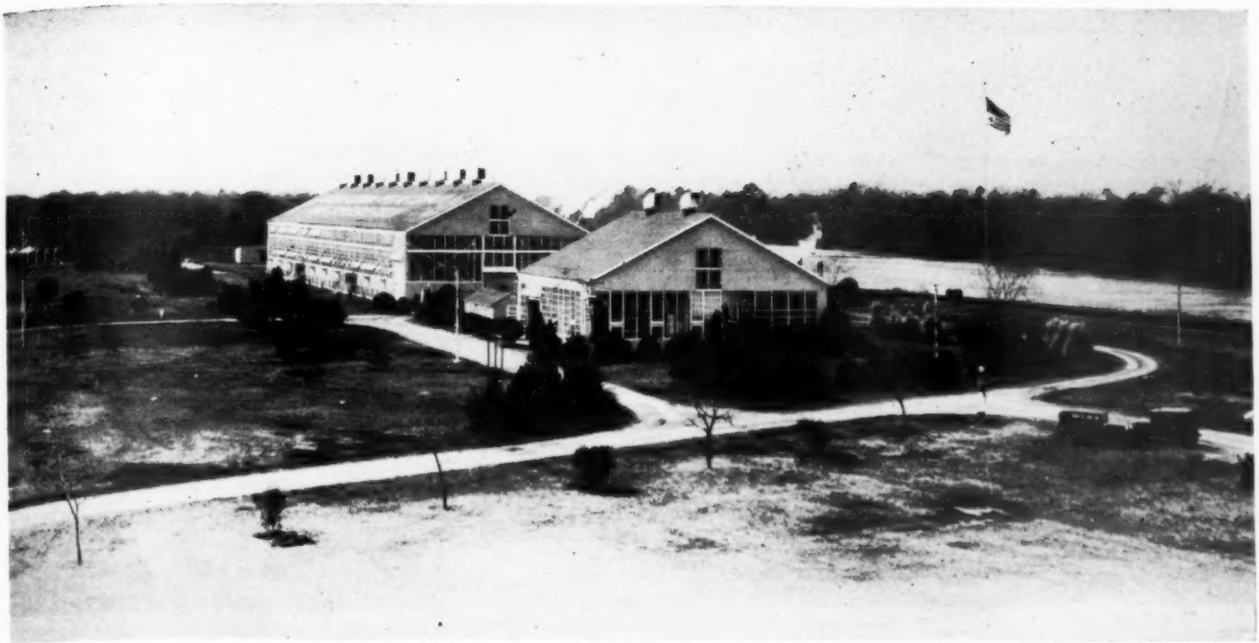


General view of Munce Compressor Station, the largest on Louisiana Arkansas Gas Company System

Efficient Operation and Maintenance of Gas Compressor Stations

PETROLEUM ENGINEER EXCLUSIVE FEATURE

An outline of the methods followed by one company in its overhaul and repair work that result in reduced operating and maintenance costs

By W. E. NESTOR
Superintendent of Compressor Stations, Arkansas Louisiana Gas Company

ECONOMY in the maintenance of natural gas compressor stations is a problem being given more thoughtful consideration by the men engaged in the supervision of the natural gas transportation industry than any other phase, as it has a decided bearing on the total cost per M cu. ft. of gas compressed, the factor in which the management is most interested.

On the lines of the Arkansas Louisiana Gas Company, there are nine compressor stations having a total of 25,700 compressor hp. There is also a total of 1900 auxiliary hp. employed in pumping water, operating starting-air compressors, generating power for illumination, and for operating motors in machine shops and other services.

Machine shops are maintained at the three principal main-line stations. At Munce Station, which is the largest station on the system, the machine shop is equipped to repair any of the largest parts of the compressors and engines, such as power and compressor pistons and rods, main bearings, cranks, wrist-pins, and other parts most subject to wear. In addition to repair work, exhaust valves and stems, compressor pistons and rods, compressor valves, and many other parts are made in the shops by company machinists.

Although some gas pipe line companies maintain a regular repair crew to do all the major overhauling, maintenance work in Arkansas Louisiana Gas Company's stations is a part of the duties of the regular operating crews at the various stations. This practice is followed because it is believed that the men in daily contact with the equip-

W. E. NESTOR

entered the employ of the Arkansas Natural Gas Company in 1911, previously having been a machinist and master mechanic with various industrial concerns—From 1913 to 1916 he was in charge of construction and operations of the Southwestern Gas and Electric Company stations in the Shreveport, Louisiana, area—In employ of Manufacturers Light and Heat Company 1916-20 and in 1920 became affiliated with the Reserve Natural Gas Company as superintendent of compressor stations—When in 1928 the various companies now composing the Arkansas Natural Gas Corporation were taken over by the Cities Service Company, he was placed in charge of all compressor stations as superintendent.

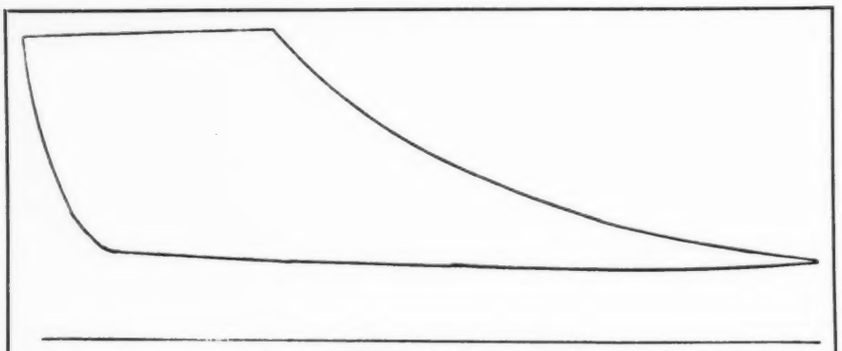


Fig. 1. Normal compressor card

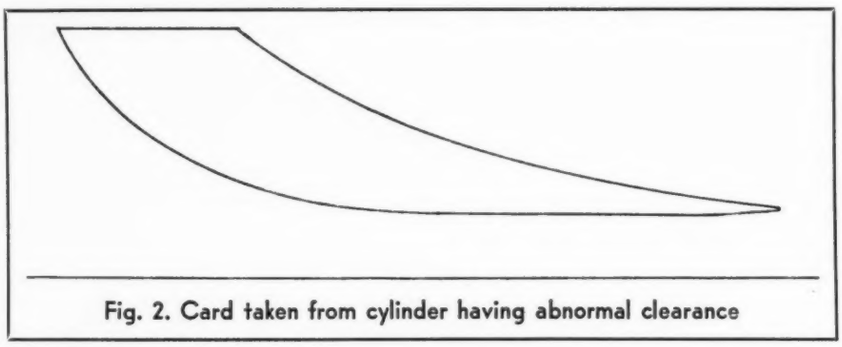


Fig. 2. Card taken from cylinder having abnormal clearance

ment are perhaps better qualified to perform the work than a floating crew, the members of which are not so likely to have the interest in seeing a good job done as the men that have to operate the plant.

Major repair work is planned for the summer months when load conditions are lightest and engines can be taken out of service for repair. In stations where load conditions during the summer months are such that enough workmen cannot be spared from the operating crew to make the necessary repairs, workmen from some of the other plants that are operating at reduced capacity are sent to assist.

One of the items of considerable expense on large double-acting gas engines is metallic piston-rod packing. In many of the older types of packing, little effort was made by manufacturers until a few years ago to change the design in a manner that would seal effectively the fire-check rings from both the high temperature and high pressure to which they are subjected. An ineffective seal is the direct cause of most of the excessive piston-rod wear at the beginning of the power stroke.

Many manufacturers adhered to the conventional styles of solid ring, tangential joint ring, or other types of joints held in place either by garter- or steel-band springs. No provision was made to reduce the area of the fire-check ring exposed to high temperature and pressure or to prevent the high explosive pressure from reaching the space on top of the ring and causing excessive ring pressure on the rods.

A few years ago a leading manufacturer developed and placed on the market a new type of fire-check in which the side of the fire-check ring is grooved. A round spring of high heat-resisting steel is inserted in the groove and the ring is installed with the spring side away from the fire. The fire-checks, made of special bronze, are installed in a floating case that effectively seals-off the pressure from the top of the fire-check rings and permits only a small section of the fire-check to be exposed to the high pressures. The construction of the floating case permits free-floating action of both the fire-check and the case itself.

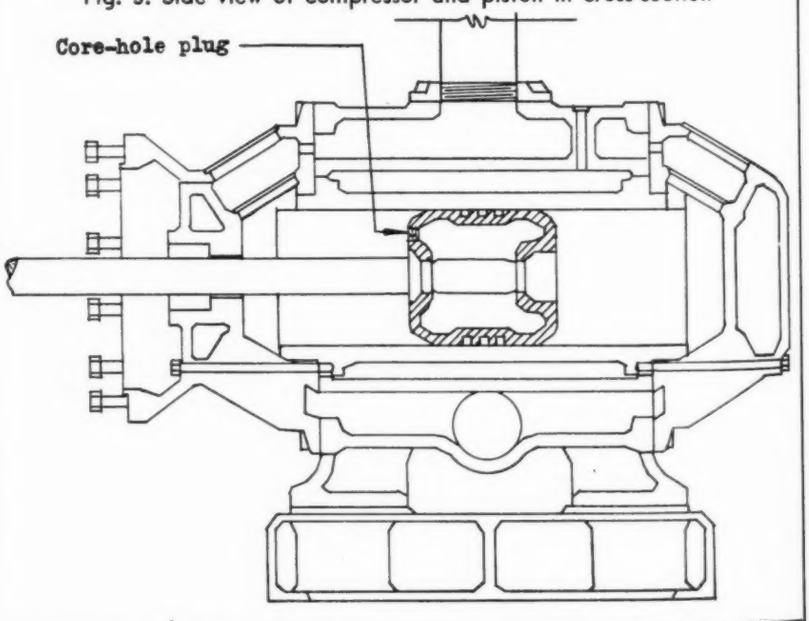
The combination of light spring-pressure on the piston rod, the use of bronze instead of cast-iron fire-checks, and the effective sealing-off of high explosive pressure and temperature eliminates rod wear and assures long life to fire-checks and packing rings. Formerly as many as seven fire-checks were used to seal-off pressure. Only three rings are necessary on this new type fire-check. An advantage of the use of a sealed case for enclosing the fire-checks is that lubrication is more effective and formation of carbon deposits is prevented.

Experiments made at Arkansas Louisiana stations and observations of installations at other companies' plants of this new floating-pressure and fire-diverting seal packing proved so satisfactory that the Arkansas Louisiana Gas Company has authorized its use on all power piston rods in future replacements.

In the operation of compressor stations more thought is being given to the selection of personnel. Placing unskilled men in charge of equipment costing from $50,000 to $1,500,000 is like putting a land lubber in charge of a sailing vessel. He is very likely to wreck the ship.

It is a policy of the Arkansas Louisiana Gas Company to engage only workmen who have had previous me-

Fig. 3. Side view of compressor and piston in cross-section



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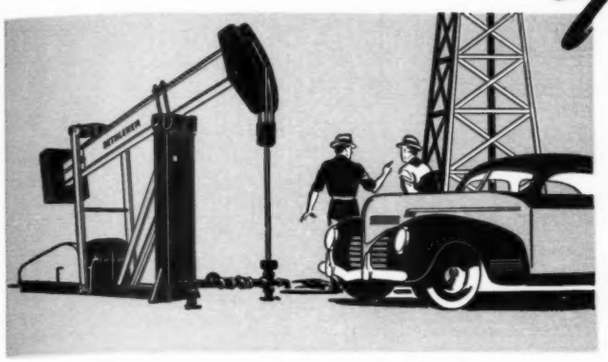

Field experience

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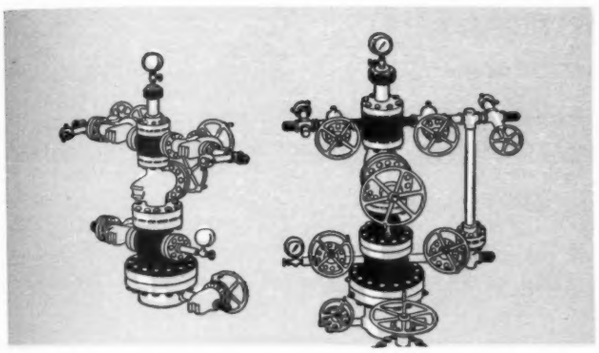
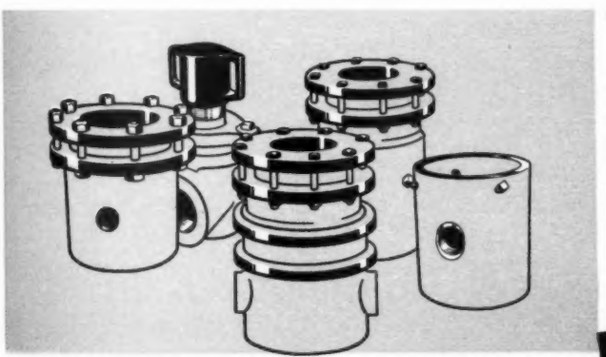


- Engineered design

Take Bethlehem-International Christmas trees. These assemblies are specially designed for easy, rapid installation. Each one is custom-made to meet particular operating conditions. Here's where B-I engineering skill and experience count—in the design and selection of the Christmas tree best suited to your well conditions.



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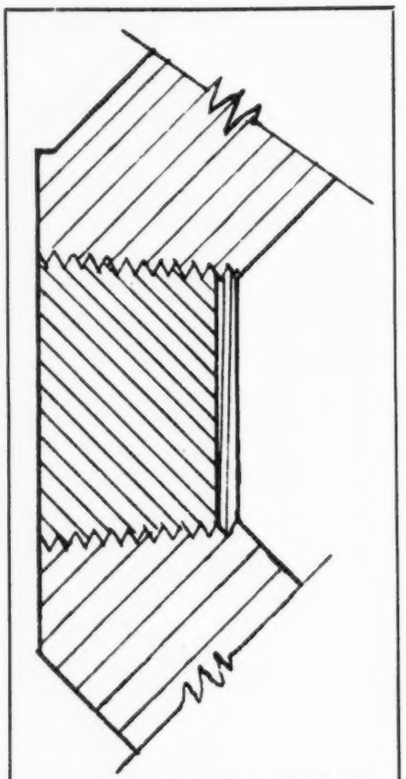

Fig. 4. Cross-section of piston with full-size plug in place and faced-off

chanical experience or who show adaptability in applying themselves to the various duties in compressor station work and to train them thoroughly in all duties that are a part of operation and maintenance.

All plant superintendents supervising the operation and maintenance of the Arkansas Louisiana Gas Company's compressor stations are men skilled in their line of work. Each has a record of 20 years or more of service with the company. It is the responsibility of these superintendents to keep the machinery in the plant in first-class condition at all times. The engine building and surrounding grounds must be clean and orderly in appearance. These men must also supervise all major repair work on the engines, compressors, and other equipment.

The assistant plant superintendent on the day shift supervises all major repair work and takes indicator cards on both the engines and compressors once each week and makes any adjustments for timing and fuel mixture found necessary from the cards. After all adjustments are made a full set of cards from each engine and compressor is sent to the main office for a check by the superintendent and his assistant.

The value of frequent checks on the engines and compressors is shown graphically by the cards presented herewith. Fig. 1 shows a normal indicator card taken under presumably the same conditions as the card shown in Fig. 2, but it discloses an area approximately 40 percent greater than the latter card.

An inspection of the compressor to determine the cause of the defect disclosed by the card revealed that one of the core-hole plugs in the inboard end of the piston had only been screwed into the piston to the extent of three threads and faced-off flush with the end of the piston. Thus weakened, the plug had been fractured and blown into the hollow section of the piston. Fortunately there was no evidence that fragments of the plug had fallen into the cylinder to score the walls. The open core-hole in the piston had the effect, of course, of converting the hollow piston into an unloader pocket.

Fig. 3 is a side view of the compressor and piston in cross-section. Figs. 4 and 5 show, respectively, cross-sections of the piston with (a) full-size plug in place and (b) a plug only partially screwed in place and faced-off flush with the end of the piston.

To remedy the defect, a new plug was installed in place of the missing plug and a subsequent card revealed the trouble had been eliminated. This is only one example of the benefits to be derived from taking indicator cards at frequent intervals.

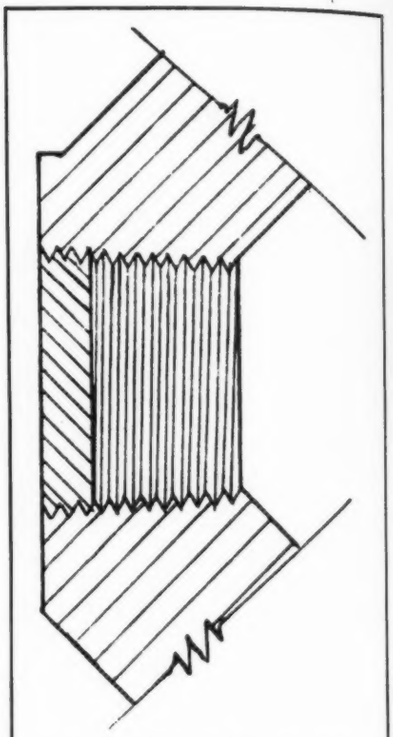

Fig. 5. Cross-section of piston with plug only partially screwed in place and faced-off flush with the end of the piston

Good supervision, well-trained operators, up-to-date tools to facilitate repair work, and the practice of safety first, last, and always, will be reflected directly in the monthly reports on operation and maintenance costs and will help make the job easier for every one concerned.

Interior view of the Munce Compressor Station

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P 532.91

Specific Problems in the Chemistry of Acidizing Wells

Acid treatment of formations containing gypsum has required special technique to prevent redeposition of any dissolved material

By

C. E. CLASON

Superintendent, Acid Division, Halliburton Oil Well Cementing Company

THE science of chemistry has developed by leaps and bounds in the last twenty years, the World War providing the impetus needed in this country because of a shortage of imported chemicals. Old ideas have been improved; application of new knowledge has made workable many formerly thought impracticable.

Acidizing a well with hydrochloric acid to increase oil or gas production is one of these old ideas revived. In 1896, two patents were issued to Frasch and Vandyke covering this procedure, but were not thought practicable until later developments in the steel industry introduced chemical inhibitors to prevent corrosion when using the acid.

A new and novel electrochemical method of preventing corrosion has been developed that is very simple, effective, and inexpensive. It has a successful record during the placing of several million gallons of acid in wells and is now standard practice for one company in connection with acidizing work.

A penetrating acid developed more than three years ago has been used to act on limestone in conjunction with acid and oil successfully under almost all conditions. The main feature of this acid in addition to its greater ability to penetrate smaller channels than ordinary acid, is the free-flowing character of the acid after it is spent. By actual measurement, it flows twice as easily as water, or the same as oil of 38° gravity A.P.I. Water alone can be treated to flow as easily. A new practice using treated water will be described.

Experience has shown that water has been the most successful medium in some areas for forcing the acid into the formation in gas-well treating. This is due to three reasons: first, the increase in speed of placing the acid; second, the washing of the formation —removing clay-like shale, etc.; and third, a dilution of the heavy spent-acid salts, allowing easier removal of the acid with less by-passing of the gas. This last feature has been found to lessen materially the time required to dry the gas by blowing out the well after a treatment. When it is remembered that spent acid contains more than 20 percent by weight of dissolved salts, it is obvious that dilution by water should be a large factor in decreasing the weight and adding to its flowing characteristics.

C. E. CLASON

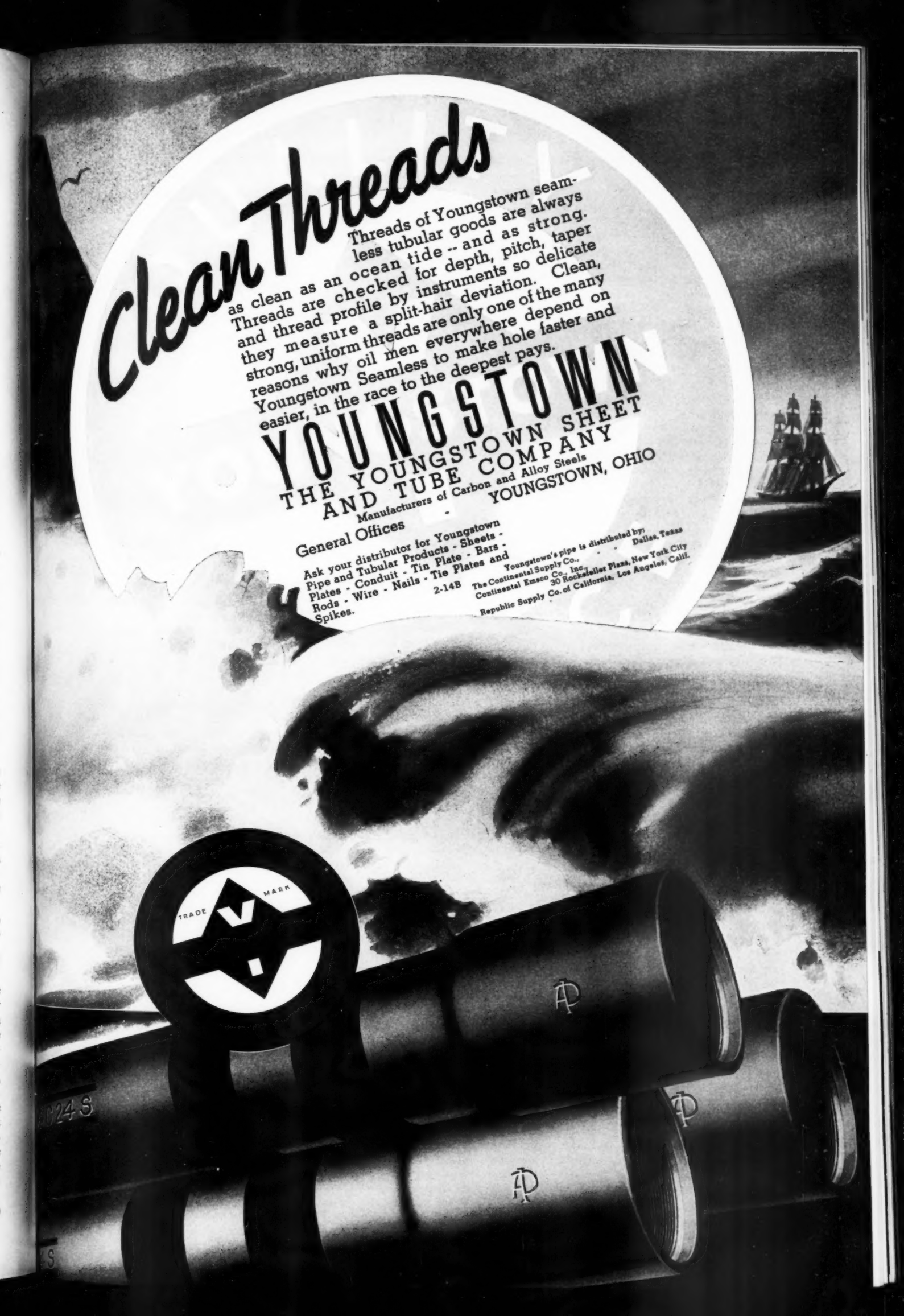
was born May 27, 1894, in Midland County, Michigan—Attended Midland High School and University of Michigan—For 20 years was with Dow Chemical Company, Midland, Michigan, as analytical chemist, plant superintendent, and doing inorganic research—In the summer of 1932 he was placed in the Acidizing Department, having charge of the Michigan district—After the formation of Dowell Incorporated, as a subsidiary company, he was transferred to Kansas in January, 1933, as district manager to pioneer the work there—In May, 1935, he entered the employ of the Halliburton Oil Well Cementing Company, as superintendent of the Acid Division.

A highly improved treatment can thus be made using any water going into the well. Between stages or following a treatment the water could contain this same ingredient, thus improving the flowing qualities of all the fluid entering the formation. Theoretically, by dilution of the salts and chemical treatment of both water and acid solution, the removal should be twice as fast as and more thorough than when plain hydrochloric acid is used. This procedure may also, in time, result in less trouble in acidized gas wells, particularly if the gas is to be used for manufacture of carbon black, because of the more thorough removal of slight traces of vaporized salts in solution and also any acid gas that may be present.

Production areas will vary in character of formation so that no hard and fast rule can be used. Too much fluid in a well in a low-pressure field may produce detrimental results. Reasoning and experience would suggest as an alternative the use of a gas compressor to force the acid and any water required into the formation. There is less danger in this method of forcing the fluid so far away from the bore of the well that it might never be recovered or return so slowly as to act as a plug.

In the Panhandle and parts of West Texas, the dolomites contain gypsum either as anhydrite or selenite. This, in chemical terms, is calcium sulphate containing water of crystallization.

During the evolution of the earth, calcium carbonate may have been altered to gypsum (calcium sulphate) either by oxidation of sulphur and pyrites to sulphuric acid and its consequent reaction with the more soluble calcium bicarbonates of lime; or by precipitation of soluble magnesium sulphate that has been formed in the same way. These reactions would result in an excess of magnesium carbonate in the formation. In other words, the ratio of calcium carbonate to magnesium carbonate is not that of a true dolomite. Calcium sulphate is present as anhydrite, frequently being the cementing material in the crystalline sugary dolomite such as is found in the Moore, Watkins, and West Pampa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pools of the Panhandle. It is also present as selenite in formations of low permeability in pools such as Borger and West Pampa.

In acidizing such a formation it would seem on first thought that this calcium sulphate, not having any chemical reaction, is harmless, but actual field work, together with laboratory experiments, have shown this to be far from true. Both forms of the sulphate are soluble or dissolve to a considerable extent in a short time. The acid then becomes nearly neutral by action on the carbonates present and apparently is unable to act upon all the remaining salts, resulting in the gypsum appearing as a heavy flocculent and, in some cases, voluminous thick mass. This precipitate acts as a plugging agent and, at times, almost nullifies completely the benefit derived from the acid.

This problem resolved itself into preventing the gypsum from going into solution or, if that were not possible, to hold it in solution. This latter procedure was worked out, and has been proved by field practice in the Panhandle and West Texas.

Dolomite samples were taken that showed an average analysis of 93 percent calcium and magnesium carbonates and 6 percent calcium sulphate. A 15 percent acid solution will dissolve 6 percent by weight of calcium sulphate under proper conditions but when acting upon carbonates at the same time only 1 percent of this material is dissolved. This will be precipitated, however, when the acid is neutralized, leaving less than 0.1 percent in solution. Holding all the precipitate in the solution means that only one-tenth as much plugs the channels as when ordinary acid is used. When it is borne in mind that this sulphate is dissolved when the acid is fresh and near the well bore, then shoved ahead out into the formation where it is precipitated, it can be seen that it is possible to have a plugging effect at the most important place in the travel of the acid.

The very nature of the Brown dolomite formation in the Panhandle makes the problem of solvent treatment a difficult one owing to the cementing material or selenite having formed local isolated spots that have no channels leading to them. Whether the chemical constituents of this barrier are limestone or selenite, there must be channels of appreciable size to allow movement of a solvent such as acid. Otherwise a blank wall results against which the acid can spend itself by surface contact and thus be unable to move ahead. In other words, if this formation had been pure limestone containing local areas having no appreciable permeability, the chances for acid action would be small.

This condition is analogous to a certain formation in Louisiana in which the horizontal permeability is small—and only one-half that of the vertical permeability. Acidizing had not been successful there in recovering more oil, the acid tending to rise to a gas formation (because of hard formation below) and failing to act horizontally. Shooting with an explosive is not successful because the limestone is too soft and seems to pack. In a hard, dense dolomite, a shot of explosive seems to be the best remedy, or perhaps a shot of explosive followed by acid might produce the desired result.

In any formation containing either form of gypsum, it is safer to use an acid that will not re-deposit any dissolved material in order to insure against a decrease in oil production. The efficacy of the treatment will depend on the success attained in enlarging the natural channels.

Magnesium carbonate is slower in its reaction with acid than calcium carbonate. Thus the acid is selective in its reaction. It will react several times faster upon calcium carbonate than on magnesium carbonate, but the magnesium carbonate may be loosened from its position in the formation, sloughing off in large quantities. This results in a plugging action that can be more of a hindrance to good results than the effect of a gypsum precipitate. Spent acid blown from a well has been found to contain great amounts of magnesium carbonate that would dissolve completely upon addition of more acid.

Trouble from this source is eliminated by slowing-up the rate of acid reaction by use of certain chemicals. In doing this, the action on the calcium and magnesium carbonate is equalized. It cannot be shown visually, but has been proved by acidizing cores —analyzing the spent acid at intervals, and demonstrating that ordinary acid, during the time when the first part of this acid is working, results in a far greater dissolution of calcium than magnesium. It can also be observed by analysis that the added chemicals produce the desired results.

Acid that delays reaction is also used in very "fast-acting" limestones in order to extend the action farther away from the bore of the well. It is known that very few minutes are required to complete acid reaction in some formations and if enough time is consumed, spent acid at the head of the flow will be shoved along without dissolving much limestone. Large capacity pumps and chemical treatment of the acid can do a great deal to alleviate this fast action. In some localities when a well is drilled into a fast-acting formation a two-phase treatment is applied. The formation in a new well may be tight when the treatment is begun, then the pressure may drop showing a vacuum at the surface. The first stage involves use of penetrating acid; when the pressure drops, the rest of the acid is treated to obtain slower reaction and the treatment continued. Old wells that will not sustain a fluid column of oil require delayed-action entirely. It is believed that these improved methods of both technique and chemical means make dolomite respond more readily to treatment. Of course, the yield per acre from old wells already produced must be taken into consideration. Some pools may have become so depleted that a higher rate in production is virtually impossible.

Other materials from chemical reaction are some forms of silica that tend to form a gelatinous mass under the action of acid. Plummer and Newcome[1] have shown that other factors enter into acidizing besides the calcareous content of the formation. They mention pore-clogging by fine needle-like crystals of acid-soluble silicates mixed with a little colloidal silicate in the spent acid, the effect of which was that results in increasing permeability were negative. They further state that "Ordinary acid treatment of very fine-grained rocks may be harmful rather than beneficial." This trouble has been found in certain areas in the Permian Basin in West Texas because of gypsum; in one particular locality the trouble was so bad that to acidize a well was considered a good way to plug it. This difficulty was overcome in 1938 by chemical treatment of the acid and one operator has had 13 successful jobs.

Thus, one feature of acid reaction was finally worked out after several years. This pertained to slowing-up the rate of reaction. Nothing has been discovered yet that will increase the rate of reaction by chemical means.

Laboratory apparatus was devised to operate under pressure using acid on formation samples and some interesting results were noted. It was found that pressure effect alone changed the preconceived ideas of acid reaction. In a test tube, carbon dioxide gas bubbles off or the solution effervesces. Various theories have been advanced on the Jamen effect produced by this gas and its effect on flow of fluids. Experiments

[1] "Laboratory Investigations on Acid Treatment of Oil Sands," A.I.M.E. Meeting, Houston, Texas, Oct., 1935.

show that increasing the pressure resulted in a lessening of this gas evolution, in other words, the gas is dissolved. When 800-lb. pressure or more is obtained, all evolution ceased, the reaction continued, but more slowly. This is in accordance with the laws of mass action, in that the removal of one of the products of a chemical reaction will speed-up the rate of the reaction and conversely, if it is not removed, the reaction slows-up. Thus if a well shows a vacuum at the surface while treating with 15 percent acid, the formation would only require a hydrostatic head or fluid column above it of about 1720 ft. to produce the pressure that would delay the rate of reaction.

A further problem heretofore unsolved deals with formation of emulsions when acidizing. Sometimes this can be predicted in advance by observing the oil characteristics, but more often it will not be discovered until after an attempt to acidize. Laboratory work had disclosed that every well will present a separate problem when this trouble is encountered. Many compounds exist that can be used as emulsion breakers but samples from each well must be studied separately in order to find the right one.

Emulsions can act in different ways to cause trouble. Introduction of acid into a formation has been found nearly impossible in some wells because of the formation of a thick, gelatinous emulsion. Other cases have occurred where the well took acid readily, but declined rapidly in oil production, the emulsion amounting to 30 percent. This extreme condition was overcome by using the proper measures to place the correct emulsion breaker in the formation with the acid. There is apparently no universal emulsion breaker.

All the chemical phases of acidizing discussed can be used separately or combined, if needed. Obviously, it is important, when possible, to examine cores, cuttings; also to observe the production of oil before and after an acid job, to determine the best method of procedure from a chemical standpoint. This should be accepted as a necessary part of the program in a pool or wildcat well where not much is known about action with acid or where trouble is encountered. This preliminary and follow-up work should be taken seriously by all operators in order to obtain the best possible service and aid in developing the best procedure for further development work.

Analysis Atlanta, Arkansas, Crude Oil

A SAMPLE of petroleum from the discovery well of the Atlanta district in Columbia County, Arkansas, is a paraffin base crude oil, according to an analysis made by the U. S. Bureau of Mines. In contrast, samples from similar producing zones in the neighboring Schuler, Village, and Magnolia fields have been found to be intermediate in character.

The crude oil sample has a gravity of 42.6 deg. A.P.I., is brownish-green in color, contains 0.49 percent sulphur, and has a carbon residue content of 0.4 percent. Distillation by the U. S. Bureau of Mines Hempel method indicates that it contains approximately 35 percent gasoline and naphtha, 20 percent kerosene distillate, and 30 percent gas oil and heavier distillates.

The oil was obtained from the No. 1 J. T. Beene well shortly after it was opened for flow in December, 1938. This well is approximately five miles south of Village, Arkansas, and approximately seven miles west of Schuler field.

The analysis of the oil is given in the accompanying table:

No. 1 J. T. Beene Well — Atlanta District — Arkansas
8201-8235 ft. — Reynolds limestone — Columbia County
Tide Water-Associated-Seaboard oil companies — Sec. 15-18S-19W, 5th Pr.

GENERAL CHARACTERISTICS

Specific gravity, 0.813. A.P.I. gravity, 42.6 deg.
Sulphur percent, 0.49. Color, brownish green.
Saybolt Universal viscosity at 77°F., 38 sec.
Saybolt Universal viscosity at 100°F., 35 sec.

DISTILLATION, BUREAU OF MINES HEMPEL METHOD

Dry distillation, Barometer, 732 mm. First drop: 34°C. (93°F.)

Temperature, °C.	*Percent cut*	*Sum, percent*	*Specific gravity of cut*	*Deg. A.P.I. of cut*	*Viscosity at 100°F.*	*Cloud test, °F.*	*Temperature, °F.*
Up to 50	1.3	1.3	0.636	91.0	.....	.....	Up to 122
50- 75	2.8	4.1	.662	82.2	.....	.....	122-167
75-100	4.5	8.6	.705	69.2	.....	.....	167-212
100-125	6.4	15.0	.738	60.2	.....	.....	212-257
125-150	7.2	22.2	.762	54.2	.....	.....	257-302
150-175	7.0	29.2	.777	50.6	.....	.....	302-347
175-200	5.7	34.9	.784	49.0	.....	.....	347-392
200-225	5.5	40.4	.790	47.6	.....	.....	392-437
225-250	6.1	46.5	.802	44.9	.....	.....	437-482
250-275	7.9	54.4	.818	41.5	.....	.....	482-527
Vacuum distillation at 40 mm.							
Up to 200	5.0	5.0	0.837	37.6	40	20	Up to 392
200-225	7.0	12.0	.842	36.6	44	35	392-437
225-250	6.7	18.7	.855	34.0	53	55	437-482
250-275	5.9	24.6	.864	32.3	72	75	482-527
275-300	5.9	30.5	.870	31.1	110	90	527-572

Carbon residue of residuum, 2.6 percent; carbon residue of crude, 0.4 percent.

APPROXIMATE SUMMARY

	Percent	*Sp. gr.*	*Deg. A.P.I.*	*Viscosity*
Light gasoline	8.6	0.681	76.3	.....
Total gasoline and naphtha .	34.9	0.744	58.7	.....
Kerosene distillate	19.5	.805	44.3	.....
Gas oil	13.2	.843	36.4	.....
Nonviscous lubricating distillate	12.8	.851-.868	34.8-31.5	50-100
Medium lubricating distillate .	4.5	.868-.873	31.5-30.6	100-200
Viscous lubricating distillate .	.....	.....	.....	Above 200
Residuum	14.6	.913	23.5	.....
Distillation loss	0.5	.....	.....	.....

Polymerization of Unsaturated Gaseous Hydrocarbons

Large proportion of cracked gases formerly wasted now made into motor fuel by recently-developed processes

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

By RAFAEL FUSSTEIG

THE recent development of several processes for polymerization of gaseous cracked products to a high liquid content of aromatic and olefinic hydrocarbons has introduced an entirely new method of manufacturing gasoline. The economic significance of these new processes may be appreciated when it is realized that now a large proportion of the cracked gases formerly wasted is being utilized as fuel in the engines of automobiles and airplanes as an important component of the so-called polymer gasolines.

Every cracking process, regardless of type, yields a certain gas that may serve as suitable charging stock for the polymerization processes. Cracked gases usually contain unsaturated hydrocarbons that, of course, enter very actively into the polymerizing reactions. For example, olefins of low molecular weight, such as ethylene, propylene, butylene, etc., form polymerization products readily under the normal conditions of polymer-plant operation.

Polymerization may be defined as a process in which two or more molecules of a substance are united to form a larger molecule, the so-called "polymer." The reaction in this polymerization phenomenon may be compared with that of processes of refining of oils containing unsaturated hydrocarbons using sulphuric acid. During the refining process, the sulphuric acid forms acid-esters or alkyl-sulphuric acids by addition with the unsaturates. These products subsequently react with another molecule of the olefin to form the "polymer." The sulphuric acid is liberated and, theoretically, may be re-cycled. As an example, if two propylene molecules are polymerized, hexylene will be obtained having twice the molecular weight of the raw material, propylene.

From the kinetic standpoint polymerization is generally considered to be a bi-molecular or second-order reaction. Considered thus, the constant k of the reaction velocity can be expressed as follows:

$$k = \frac{x}{at\ (a - x)}$$

RAFAEL FUSSTEIG

has been affiliated with the petroleum industry since 1923, principally as chemist and engineer—At present he is professor of petroleum technology in the Ecole Superieure Technique et Commerciale de Paris, Paris, France, and maintains an office as consulting petroleum engineer at Jaroslaw, Poland, Kraszewskiego, 16—He plans soon to come to the United States to establish his headquarters.

in which x is the proportion of original reactant converted in the time t, and a is the total reactant as the reaction begins.

Gaseous hydrocarbons obtained in the pyrolysis of petroleum under the influence of high temperatures are rich in reactive unsaturates. It should be noted, however, that polymerization of unsaturates into gasoline-type hydrocarbons is not a new idea. Day[1], dealing with this problem in 1866 observed the possibility of transforming gaseous unsaturated hydrocarbons into liquid compounds, but the significance of this to the oil industry was not, of course, recognized at the time.

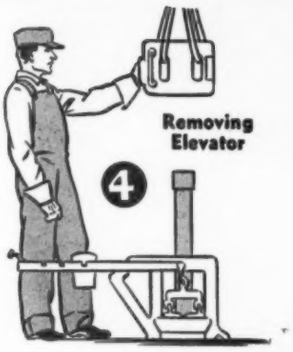
Employing polymerization, it is evident that the more olefins contained in a gas the greater will be the yield of gasoline. The tendency, therefore, in modern refining is to produce gases containing higher percents of unsaturated fractions and, thus, obtain a more valuable charging stock for polymerization. The most logical initial step in adopting the polymerization process is to construct plants to utilize vapor-phase gases as they are especially rich in unsaturated hydrocarbons.

The polymerization of olefins is a highly exothermic reaction. If the heat evolved is not dissipated, the operating temperature will rise, the velocity of polymerization will increase, and this will, in turn, result in a more rapid evolution of heat. Waterman and Tulleners[2] have observed that ethylene decomposes with explosive violence when submitted to a temperature of 350°C. (660°F.) and to a pressure of 2489 lb. per sq. in. Sullivan, Ruthruff, and Kuentzel[3], in their studies of this problem, did not observe this effect but in many experiments the temperature did increase inordinately. In one test, for example, the temperature continued to increase after the heat input to the bomb had ceased. Increasing to a temperature of about 650°C. (1202°F.), the heat remained constant for two hours, after which the temperature decreased. When the bomb was opened it was filled with carbon, indicating clearly that a temperature of 650°C. (1202°F.) is too high for the proper transformation of olefins into gasoline.

Consequently, the selection of the proper temperature is important in obtaining a satisfactory polymerization reaction. At low temperatures, in the absence of catalysts, the olefins require a long heating period before good yields of liquid products may be obtained. At higher temperatures the rate of polymerization is increased but it is more difficult to control the types of products obtained. Dunstan, Hague, and Wheeler[4] conducted experiments with various olefins at high temperatures in a flow process. Using a pressure of 90 atmospheres and a contact time of two to three hours, they obtained 80 to 92 percent yields of liquid products from ethylene.

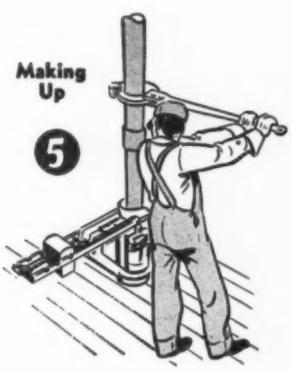
Froelich and Wiezevich[5] have also studied the polymerization of olefins

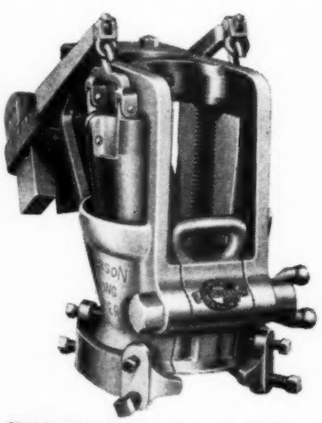
HOW THE WORLD'S MOST EFFICIENT SPIDER OPERATES



Follow these 6 steps and you'll clearly see that the GUIBERSON is the world's best and safest spider—and why:

1. Derricks are not in absolute alignment. Tubing almost always hangs off center, dragging against one side of well. Weight on spider lever is adjusted to lift slips from bowl. Tubing hangs free and "drags". Spider is rotated until its "guide head" is in position to directly oppose the "tubing drag".
2. "Guide head" is then adjusted so that it pushes tubing to center of hole. Tubing now drags against "guide head" and is guided to exact center of well. This "guide head" is a very important exclusive patented advantage.
3. Running in, most operators either remove weight or adjust it so slips will drop in bowl. Slips are then raised by placing foot or hand on lever, but can instantly be dropped in bowl to grasp tubing, in case of emergency or when ready to make up another stand of tubing.
4. When ready to make up another stand of tubing, foot or hand merely releases lever—slips drop accurately into bowl and grasp tubing. Elevator is removed.
5. In making up, a back-up wrench is seldom used, as the spider's grip on tubing is strong and adequate.
6. Coming out, weight is either removed or so placed that slips drop in bowl and "ride" the upward moving tubing. Should a drop occur, slips automatically grasp the tubing and hold it fast.





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under a variety of conditions. In one experiment a yield of 10 gal. of liquid products per M cu. ft. was obtained at 400°C. (752°F.) and 2000 lb. per sq. in. pressure, 68 percent of the liquid boiling below 225°C. (437°F.). In other experiments a yield of 11 gal. of liquid products per M cu. ft. was obtained at 400°C. (752°F.) and 2700 lb. per sq. in. Heating time varied from 8 to 12 hours. When the contact time was reduced to 19 seconds, the best yield obtained from ethylene was 3.7 gal. per M cu. ft. at 600° C. (1112°F.) and 800 lb. per sq. in. In the latter test, 91 percent of the liquid boiled between 30°C. and 225°C. (86°F. and 437°F.).

The above and similar experiments have served to demonstrate to the chemist interested in polymerization that contact time and temperature are important considerations. Considering the variety of unsaturates contained in cracked gas, each having a different reaction velocity, it is difficult to determine the exact temperature at which best results will be obtained for a specific gas. As stated by Dunstan, butylene requires higher temperature and pressure for the same yield of liquid than pentylene, and propylene even more severe conditions than butylene. The reaction-rate can be regulated by the pressure. The higher the pressure the more concentrated the reaction will be. The additional benefits derived from operation at high pressure must be weighed, of course, against the cost of equipment to withstand such pressure. An economical method of operation consists of polymerizing the cracked gases catalytically. A large number of catalysts have been proposed by many investigators for the polymerization of olefins. Among these may be mentioned aluminum chloride, silicon, silicon tetrachloride, copper and noble metals, titanium tetrachloride, boron fluoride with hydrogen halide, stannic chloride, phosphorous pentachloride, ferric chloride, activated clay, activated carbon, phosphoric acid, sulphuric acid, zinc chromite, ammonium molybdate, magnesium oxide, bauxite, etc.

Silicates also show catalytic properties when used properly. This may be explained partly by the characteristic structure (in silicates) of microscopic channels electrically charged, as evidenced by an active field created by fluctuations of certain electrons and nuclei. When the gas to be polymerized is subjected to the action of silicates, olefins will be adsorbed by the microscopic channels. Under the influence of the electronic fluctuations, the olefins will be split and rearranged in a manner depending upon the character of the fluctuations. Certain silicates used as catalysts may result in the formation of aromatic hydrocarbons. Others may effect the formation of olefinic hydrocarbons and certain types of silicates may effectively polymerize di-olefines. The latter method is employed in the Gray system, a treating process involving removal of di-olefines and other unsaturated hydrocarbons from gasoline. Marek and McCluer[6] found that silica gel as a catalyst influences the polymerization of propylene to aromatic hydrocarbons at a temperature of about 650°C. (1202°F.). In a patent obtained by the Pure Oil Company[7] it is stated that the catalytic action of the clay at temperatures between 170°C. and 370°C. (338°F. and 698°F.) and pressures between 40 and 100 atmospheres will cause gaseous olefins to be polymerized to obtain a good yield of first-grade gasoline. Gayer[8] prepared a synthetic alumina-silica catalyst that is even more active in polmerizing propylene at atmospheric pressure than floridin clay. An explanation of the greater activity of this synthetic substance may be that the electrons and nuclei of this artificial product show stronger fluctuations in the microscopic channels of the material.

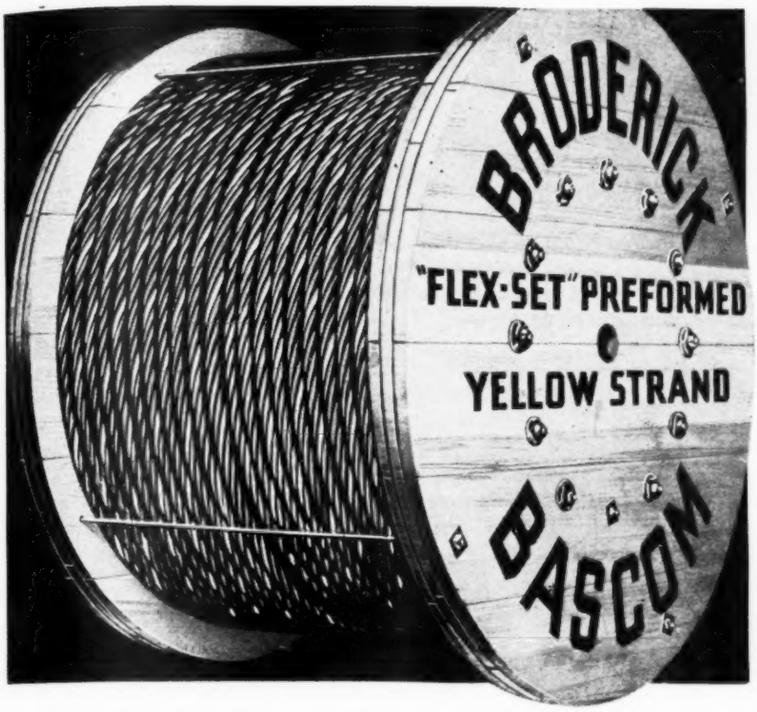
Lebedev and Borgman[9] have studied the polymerization of iso-butene in the presence of floridin and have found this to be a reversible reaction. At lower temperatures such as minus 65°C. and minus 105°C. (minus 149°F. and minus 221°F.) polymerization to dimers and higher polymers takes place faster than depolymerization. At temperatures above 15°C. (59°F.) the relation of the two reactions may be reversed. In one instance, 2-butene formed 43 percent dimers, 15-18 percent trimers, and 22-24 percent higher polymers—a total of 80-85 percent polymers by contact for a period of six months with floridin. Other investigators have shown that certain amounts of bleaching clay artificially activated with carbon and employed as a catalyst for olefinic vapors will effect polymerization. The amount of reaction depends, however, upon temperature of the vapors, upon the ratio of clay to active carbon, upon the contact time, and, of course, upon interior structure of the clay.

Ipatieff and Grosse[10] have studied the catalytic polymerization of ethylene in the presence of aluminum chloride at room temperature and a pressure of 20 atmospheres. They found that ethylene may be polymerized into higher olefins followed by transformation into naphthenes and subsequent conversion into paraffinic hydrocarbons and unsaturated naphthenes. This chain of reactions suggests that in the polymerization process the aluminum chloride catalysts may effect a concentration of the hydrogen migration to produce paraffins and naphthenes. This reasoning is based upon the fact that aluminum chloride forms in the first phase a chain of $=CH_2$ molecules, part of which become closed into cyclic compounds and part of which collect and attach themselves to migrating hydrogen atoms, enter into reaction with them and, thus, are converted into paraffinic hydrocarbons.

The catalytic polymerization process using aluminum chloride may be conducted at normal pressure because it is possible to regulate reaction velocities by a control of temperature fluctuations. An increase in temperature will cause a weakening in different bonds the effect of which is difficult to predetermine. The higher the temperature the more intermediary reactions may occur. In the absence of the stabilizing influence of a catalyst all reactions exhibit erratic tendencies The purpose of the catalyst is to insure definite desired reactions at a specific temperature. The catalyst may, of course, produce entirely different compounds at other temperatures. At lower temperatures, the polymerized chains will be shorter; at higher temperatures they will be longer. Thus, aluminum chloride as a catalyst may influence the polymerization of olefins into gasoline-type hydrocarbons, lube-oils, paraffin waxes, or even higher molecular solid resins depending upon the temperature employed in the process.

Similar catalytic action may result from the use of the chlorides of zinc, iron, etc. Brandes, Gruse, and Lowy[11] have studied polymerization using anhydrous zinc chloride as a catalyst. They have submitted propylene to pressure and a temperature of 150°-310° C. (302°-590° F.) in a polymerization process in which zinc chloride was distributed on the surface of pea-size pumice. The experiments were conducted in a closed pressure apparatus under variable conditions of temperature, pressure, and time.

In these experiments they found the yield of liquid hydrocarbons varied from 43.5 to 74.2 percent. The liquid products contained paraffins, olefins, and naphthenes, the bulk of which boiled below 200° C. (392° F.). At a



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temperature of 200°-210° C. (392°-410° F.), a pressure of 2050 lb. per sq. in., and a contact time of 60 minutes, the yield of liquid products was 43.5 percent. The maximum yield of 74.2 percent liquid products was obtained at a temperature varying between 290°-310° C. (554°-590° F.), a pressure of 1600 lb. per sq. in. and a contact time of 90 minutes. The control experiments, in which no zinc chloride catalyst was present, showed practically no conversion of propylene to liquid hydrocarbons. This absence of conversion was pronounced at 200°-210° C. (392°-410° F.) and at 150°-160° C. (302°-320° F.). The 4.3 percent conversion in the control experiment that did occur at 290°-310° C. (554°-590° F.) may have resulted from a mild catalytic action of the steel walls in the pressure apparatus used in the experiment.

In recent years phosphoric acid and certain of its derivatives have been proved excellent catalysts. Ipatieff[12] was the first to observe this fact. He conducted experiments with ethylene at temperatures of 250°, 280°, 300°, and 330° C. (482°, 536°, 572°, and 626°F.) using phosphoric acid as a catalyst. Catalytic polymerization of ethylene in this manner yielded a mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons. Thermal polymerization of ethylene (without catalysts) at similar temperatures did not yield aromatic hydrocarbons. The fundamentals of the ethylene polymerization have been explained by Ipatieff and Pines in the following manner: The first step in the reaction is the formation of ethyl phosphates. This fact was proved by a special experiment to determine the action of ethylene on orthophosphoric acids under pressure. At 180°C. (356°F.) and an initial pressure of 50 atmospheres a rapid absorption of ethylene was observed as the pressure increased. When the pressure became constant the experiment was discontinued and the product of the reaction was examined. The monoethyl ester of phosphoric acid first formed had been converted into a barium salt, an analysis of which showed phosphor, 12.1 percent; barium, 53.3 percent. In the first phase the phosphoric acid forms a monoethyl ester with ethylene. The ethyl phosphates being unstable at higher temperatures, decompose to ethylene polymers and naphthenes. In the second phase the naphthenic hydrocarbons undergo a dehydrogenation reaction, resulting in the formation of aromatic hydrocarbons. Olefin hydrocarbons are then hydrogenated to paraffinic hydrocarbons in combination with the hydrogen atoms resulting from the dehydrogenation of the naphthenes to aromatics.

The last-mentioned investigators established the theory that the percentage yield and the percentage composition of the products above 250°C. (482°F.) remain practically constant whether the polymerization of ethylene is continuous or intermittent, i.e., whether one charge of ethylene is used or whether the process is repeated in the same bomb using two or three successive charges of ethylene. An increase in the aromatic content is accompanied by an increase in the paraffin content of the lighter fractions, especially isobutane, the amount of which reaches 18.8 percent at 330°C. (626°F.).

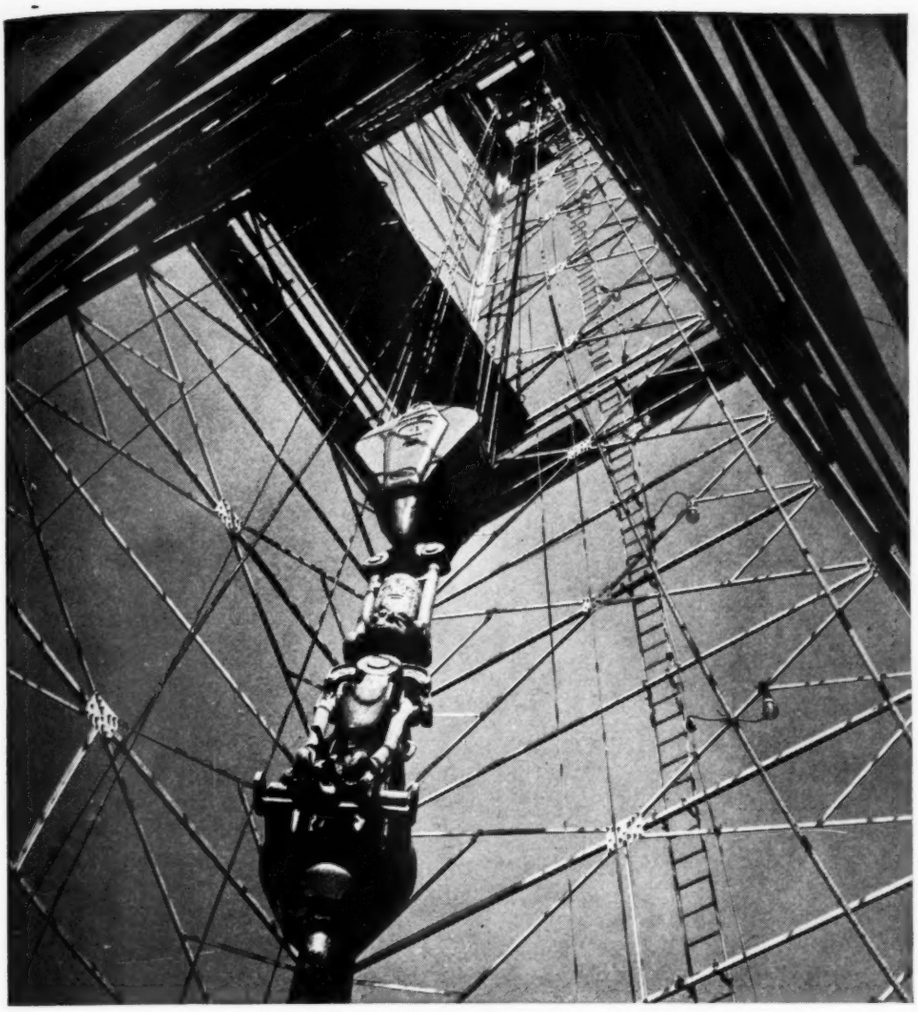
The theory of iso-butane formation in the polymerization process using phosphoric acid as a catalyst is explained by Ipatieff in this manner: The first product of the polymerization of ethylene is 1- or 2-butylene, which may be hydrogenated to form n-butane. Undoubtedly, an isomerization of 1- or 2-butene into iso-butene first occurs and the latter, hydrogenated, forms iso-butane. Experiments involving this reaction have shown that n-butane does not isomerize into isobutane in the presence of phosphoric acid. Ipatieff has shown the possibility that 1-butene may isomerize into isobutane in the following experiment: pure 1-butene was heated to 330°C. (626°F.) with phosphoric acid in the presence of hydrogen, the initial pressure of which was 100 atmospheres. After heating for 12 hours, a liquid polymer and a gas were obtained and the latter was subjected to an analysis according to the method of Podbielniak. The gas, condensable at minus 70°C. (minus 158°F.), consisted of 50 percent iso-butane, a small quantity of n-butane, and the unreacted n-butene. The amount of iso-butane formed represented 6 percent of the reacted n-butene.

Based on these investigations Ipatieff[13] proposed a patent in which he describes the polymerization of ethylene in the presence of commercial "solid phosphoric acid" as the catalyst. The operating pressure designated in this patent is 7 to 13 atmospheres at a temperature of about 300°C. (572°F.). This process results in a liquid yield of about eight gal. per M cu. ft. of charging stock, from which five gal. of 82-octane gasoline may be obtained. The charging gas from the cracking unit, however, not only contains olefins that may be polymerized but paraffinic and aromatic hydrocarbons as well. Consequently, cyclization, hydrogenation, dehydrogenation, and isomerization, in addition to polymerization, will take place in this process. These accompanying reactions Ipatieff proposes to call "conjunct polymerization" in order to differentiate them from pure polymerization.

Dunstan and Howes[14] have found that the use of cadmium phosphate in the polymerization of ethylene will result in a good yield of 78.5 octane gasoline. Malishew[15] found that phosphorus pentoxide is more active in the polymerization of ethylene and other olefins than orto- or meta-phosphoric acids. Physical properties of phosphorus pentoxide are similar to those of aluminum chloride. Likewise the chemical reaction of hydrocarbons with phosphorus pentoxide shows an approximate similarity, that is, it causes a decomposition of hydrocarbons below 100°C. (212°F.). Using phosphorus pentoxide, polymerization of butylene into liquid may occur even at room temperature. Phosphorus pentoxide will also effect an isomerization of normal butylene resulting in the formation of ramified chains. The use of phosphoric acids will not produce these results. Polymerization of ethylene in the presence of phosphorus pentoxide and lampblack as catalysts at temperatures to 260°C. (500°F.) has yielded a product of 81.5 octane number, boiling between 20° and 205°C. (68° and 401°F.), and containing olefinic, paraffinic, naphthenic, and aromatic hydrocarbons. Phosphorus pentoxide does not attack the metal parts of the reaction chamber walls and is, therefore, preferable to aluminum chloride or phosphoric acid in the polymerization of olefins.

Recently, S. H. McAllister[16] has proposed the catalytic polymerization of butylenes using sulphuric acid as a catalyst to form iso-octane. The result is dependent upon the acid strength and the processing temperature. When cracked gas is passed through sulphuric acid, iso-butylene, one of the more reactive of the olefins, is selectively absorbed into the acid phase resulting in di-isobutylene, which, after a mild hydrogenation, is transformed into the iso-octane.

According to Birch, Pim, and Tait[17] the formation of nonenes by the action of sulphuric acid on mixtures of tertiary-amyl alcohol with secondary- or tertiary-butyl alcohols is of considerable interest because of the type of condensation reactions. Nametkin, and



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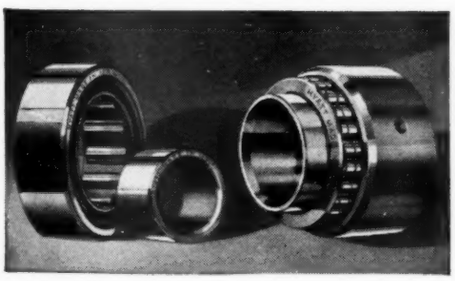

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Abakumovskaja[18] have found another interesting reaction, the so-called "hydropolymerization," i.e., polymerization of iso-butylene, amylene, iso-propylethylene, and octene and simultaneous hydrogenation of the products to form paraffins, termed hydropolymerides, under the influence of concentrated sulphuric acid.

The oxides or oxygen salts of thorium, molybdenum, uranium, aluminum, lithium, magnesium, cadmium, zinc, tungsten, iron, etc., can be used as catalysts, of which the oxides of thorium, zinc, and especially that of uranium show fairly good results. Different metals also can be used as catalysts in the polymerization process. Yoshimi Konaka[19] has studied the influences of copper and silver upon the activity of cobalt as a catalyst, and has found that catalysts of the cobalt-silver series are reduced with greater difficulty than are catalysts of the cobalt-copper series. He found that the cobalt-silver catalysts aid in obtaining more liquid polymer than the cobalt-copper catalysts. As more copper or silver was added to the cobalt catalyst, less liquid polymer and more gaseous polymer were produced. At a temperature between 250°C. and 290°C. (482°F. and 554°F.) the cobalt-silver catalyst produced a good yield of polymer but the reaction rate of ethylene was low and its activity diminished very quickly. At higher temperatures, poor yields of polymer were obtained but a high reaction rate of ethylene and good catalyst action were observed.

At 320°C. (608°F.), an interesting decomposition of either ethylene or the products of the reaction occurred resulting in the formation of methane, hydrogen, and carbon. The best yield of liquid polymer and most efficient use of the catalyst were obtained at a reaction temperature of about 290°C. (554°F.) in experiments using a catalyst containing cobalt, silver, and uranium oxide. The optimum space velocity in this instance was about 40 volumes of ethylene per unit volume of catalyst. A rapid flow rate of ethylene resulted in the greater part of the ethylene being changed to the polymer but the reaction rate of ethylene was low. When ethylene was introduced at a slow rate decomposition of the ethylene and the reacted products was more pronounced. The polymerization reaction of ethylene in the above-mentioned process was accompanied by the formation of acetylene and ethane. From this fact, it may be concluded that hydrogenation and dehydrogenation also may occur in the presence of this catalyst.

Reviewing the foregoing considerations, it is apparent that each type of catalyst acts in a slightly different manner in the catalytic polymerization of olefins. Of course, the composition of the charging stock is important because certain hydrocarbon proportions in the gas-mixture will, in the polymerization process, result in intermediate reactions in which certain unknown hydrocarbons will be formed. These intermediary products, acting as transitory catalysts may change the direction of the reactions and, thus, interfere with the expected action of the respective catalyst employed.

Thermal Polymerization

As mentioned previously, the polymerization of olefins can also be conducted without the use of catalysts, a process that is termed thermal polymerization. In this process, high pressure and relatively high temperature must be used. It has been stated[20] that ethylene and iso-butylene subjected to a temperature of 400°C. (752°F.) and a pressure of 70 atmospheres will form liquid hydrocarbons containing paraffins, olefins, and naphthenes. No aromatic hydrocarbons have been observed in the products under these conditions. An increase of pressure results in a smaller yield of naphthenes and an increased yield of unsaturated straight-chain hydrocarbons. This effect of increased pressure may be offset by reducing the temperature. Likewise, higher temperatures must be accompanied by lower pressure in the thermal polymerization process.

Thus, it should follow that olefins may be polymerized at normal pressure by employing a high operating temperature. As a matter of fact, many investigators have established that polymerization of liquid hydrocarbons from olefins will occur under these conditions. At constant temperature and an increased contact-time the specific gravity of the liquid polymers will be higher. Stated as a rule, the greater the contact-time the higher the specific gravity of the liquid products formed in the thermal polymerization process.

The high gravity results, principally, from an increased formation of aromatic hydrocarbons. A liquid product resulting from a long contact period shows a high percent of benzol, toluol, etc. R. C. Wagner[21] has studied this problem and has concluded that the polymerization of olefins under higher temperatures leads to the formation of gasoline containing aromatics chiefly. According to Wagner, 100 cu. ft. of a gas having a content of 20-24 percent ethylene, 13-18 percent propylene, and 6-10 percent unsaturated hydrocarbons having four carbon atoms processed in a thermal polymerization apparatus at a temperature of 510° C. (950°F.) and a pressure of 56 atmospheres will yield 33 liters (8.7 gal.) of liquid products. The gasoline obtained in this process has a boiling range between 33°C. and 200°C. (104°F. and 392°F.))and an octane number of 96. When using lower pressures and temtemperatures of 650°-700°C. (1202°-1292°F.) the liquid products are quite aromatic in character and the gasoline has a still higher octane number.

Summarizing the various phenomena that have been discussed, it has been shown that the polymerization of olefins can be obtained in either of two distinct types of processes. Such conditions may exist:

1. Using catalysts in the so-called catalytic polymerization process.
2. Using a proper combination of pressure and temperature (in the absence of catalysts) in the so-called thermal polymerization process.

Both of these processes have been accepted and are being given an important place in the oil-refining industry. A detailed description of the more important operating methods involving these processes will be discussed in a later issue of *The Petroleum Engineer.*

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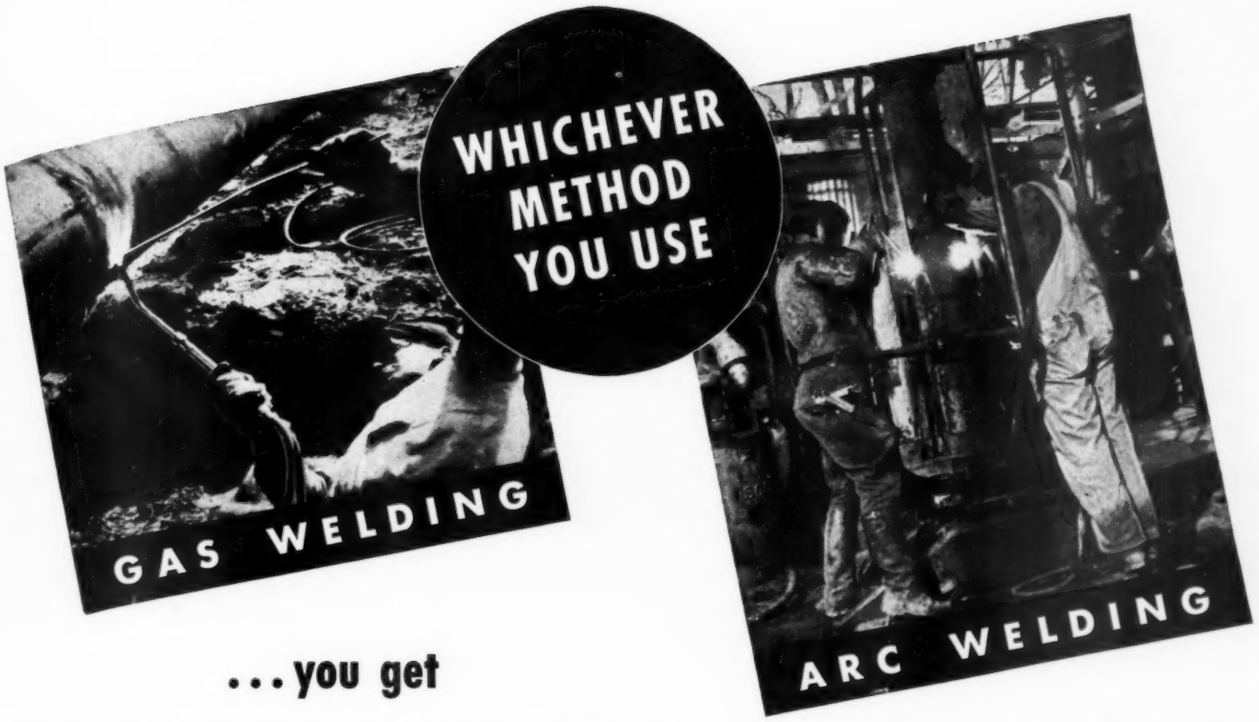

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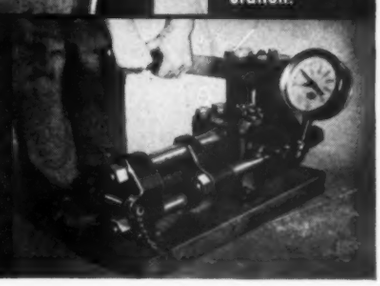

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By
WALLACE A. SAWDON
Pacific Coast and Foreign Editor

A NEW method for determining the content of subsurface formations while they are being drilled and of logging the depth and thickness of these formations has recently been made available for general use. Based on the fact that the oil, gas, or salt water content of any formation drilled by the bit will be carried to the surface by the circulating fluid, the content of any unit volume of the drilling mud can be disclosed by tests made at the surface. Employing a method of correlating the analysis disclosed by the tests with the depth of hole at the time the unit volume was passing the bit, it is thus possible to determine whether the particular part of the formation being drilled contains gas, oil, or salt water and the relative quantities contained.

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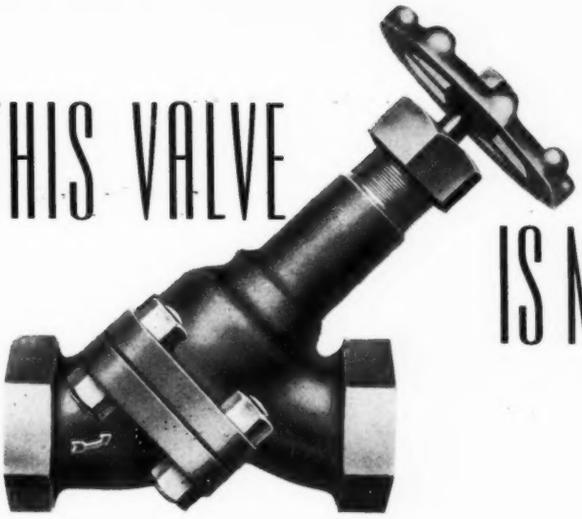

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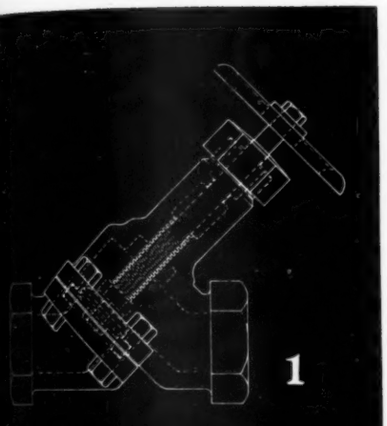

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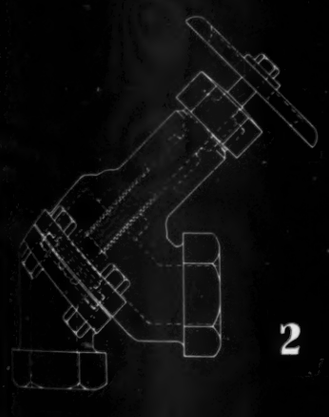

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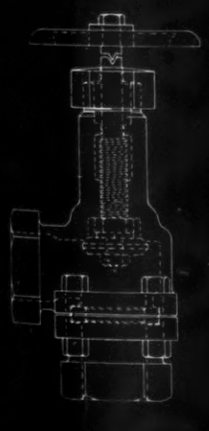

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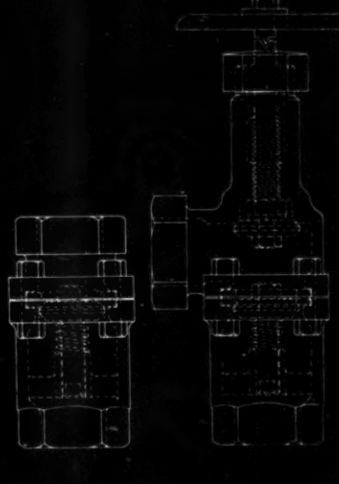

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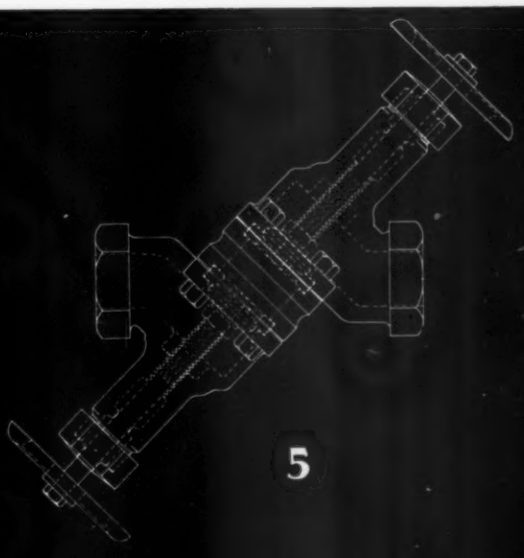
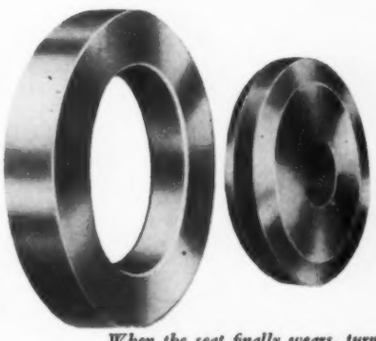


5

1. **You can use it in this conventional 180° type . . . or**
2. **Convert it to a 90° angle like this . . . or, with a slight change . . .**
3. **You can have this 90° line valve arrangement . . . and**
4. **You have this valuable combination by simply adding the check . . . or**
5. **You can even go into the double valve arrangement, 180° angle by doing this.**



When the seat finally wears, turn it over, and you have a new valve.

HUNT TOOL COMPANY

Main Office and Plant: Houston, Texas
Field Shops: Bay City and Corpus Christi, Texas; Jennings, Houma, and Shreveport, La.

A BUSINESS BUILT ON SERVICE

pump-stroke counter by a flexible lead is a second counter set to maintain a predetermined constant number of strokes ahead of the main counter. This instrument facilitates the work of the operator and eliminates much calculation.

The volume of the hole and the number of pump strokes required to bring a sample to the surface can be calculated theoretically, but it is advisable to supplement the theoretical calculations by actual tests that can easily be made. Whether the pump runs "slow" or "fast," any change is gradual and by making an occasional test the accuracy can be maintained. Accurate logging is dependent on this instrument because an attempt to use time as the basis for figuring the lag between the cutting of the sample and its arrival at the surface results in inaccuracies.

The equipment used to detect gas consists of a special trap mounted on the mud flow line from which a motor-driven vacuum pump mounted behind the instrument panel draws air through a filter, a dehumidifier, a meter, and a "hot wire" gas detector. It has been found in using this gas detector during drilling that an approach to oil and gas sands may be indicated 15 to 20 ft. before the sands are actually penetrated if the sensitivity of the instrument is increased to the maximum by the use of special features. The instrument will detect the presence of 0.25 percent gas in the stream. For any given gas sand and setting of the instrument the readings will depend upon the rate at which the formation is being drilled and upon the diameter of the hole. The readings will not be influenced by the rate of circulation as the mud is merely the transportation medium bringing the gas to the surface. When plotting the logs the recorded values are obtained by multiplying the instrument readings by a factor determined by the rate of drilling and size of hole.

Oil is detected by means of ultra-violet light. The equipment used is an improved ultra-violet oil detection apparatus incorporating a magnifying glass and facilities for flooding the sample with visible light as well as ultra-violet light. The oil in the sample appears as very small bright specks under the ultra-violet light. By observing a fluorescent spot through the magnifier and then switching on the source of visible light it is possible to distinguish crude oil from other oils that may accidentally get into the mud. Even crude oil from a previous show may usually be distinguished from a new show.

The samples for oil detection are obtained from a sampler placed in the mud stream at the mouth of the well. Intermittent samples grabbed from the stream while drilling oil sands vary greatly in oil content and are likely to be misleading, so this sampler collects an average sample of the mud passing the bit between predetermined depths. A correction factor for rate of drilling, diameter of hole, and rate of mud circulation is used in correlating oil readings.

In detecting salt water it is necessary to compare the ingoing mud with the outgoing mud because water and chemicals may be added in the pits. The method used for determination of the salt water consists of placing electrodes in the ingoing and outgoing mud streams and comparing the electrical resistances, making proper allowance for the time required for the mud stream to traverse the subsurface circulating system. The resistance of the mud, in addition to being affected by the salinity, is also affected by the temperature, which may vary considerably. Mud-caking of the electrodes is prevented to eliminate chances of incorrect readings. The instruments in the trailer include a Wheatstone bridge designed to correct the readings automatically for temperature so that the recorded resistance is corrected to standard base temperature.

It is important that cuttings in the mud be obtained from the actual formation drilled by the bit so that inflow from upper strata is excluded. Should inflow occur, the method could not be employed satisfactorily because the inflow would continue after the bit had passed beyond the horizon being tested. Such inflow seldom occurs, however, because the pressure of the mud column exceeds that of the formation in normal drilling. False shows have been obtained due to inflow immediately after a round trip and in one instance a strong gas flow appeared just before a blowout.

This logging method is adaptable either for continuous logging of wildcat wells or for completion of wells in known sands. Experience has shown, however, that it may have uses other than those directly connected with well logging. For instance, the pump stroke counter has proved valuable in warning of wash-outs. When a wash-out starts, the pump rate begins to increase and continues to increase slowly until failure of the pipe occurs. This usually occurs over a period of several hours. Because the direct-acting steam pump used in rotary drilling is a constant-pressure device, the pump speeds-up and maintains pressure when a leak begins underground. This speed increase is too gradual to be observed by the driller but it is easily noted on the pump stroke counter and rate meter. Where this instrument has been in use the operator has been able to warn the driller when a wash-out has begun so he could pull the pipe and locate the wash-out before failure occurred.

It has also been found when readings are slow that the walling properties of the mud are poor and caves are being washed in the walls of the hole. On the other hand, when the readings are fast there is an indication that circulation may be too slow or that the mud is not sufficiently thick to carry the cuttings to the surface. Such a condition should be corrected to eliminate the hazard of stuck drill pipe.

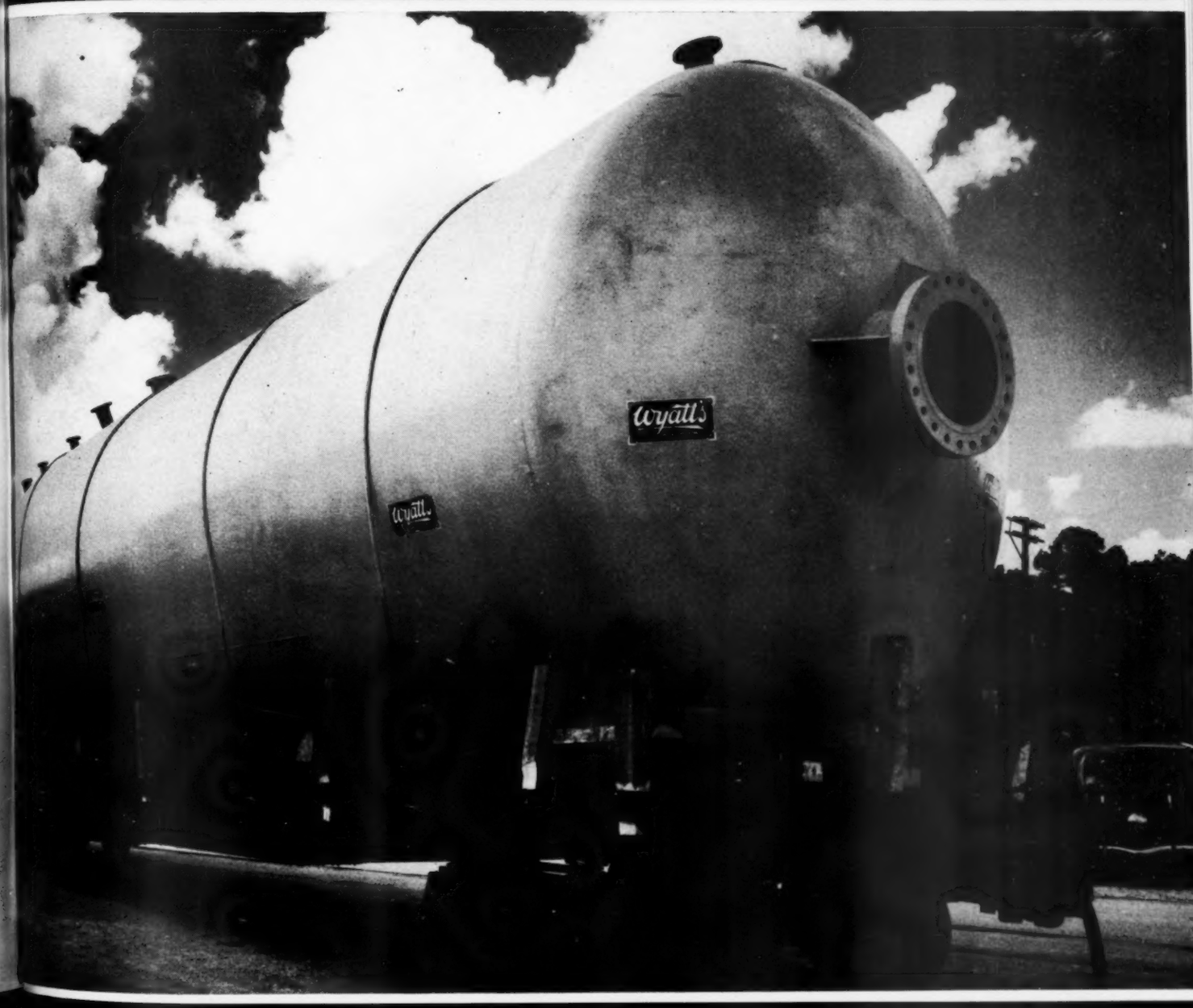
Equipment used in making tests and correlating samples is housed in a trailer

196 TONS *of Pressure Vessel*

. . . *By* Wyatt's

Diameter: 12' - 6"; Length: 115' - 7"; Weight: 392,000 pounds. This class of pressure vessel is regularly in production in our plants.

WYATT METAL & BOILER WORKS . . . HOUSTON & DALLAS



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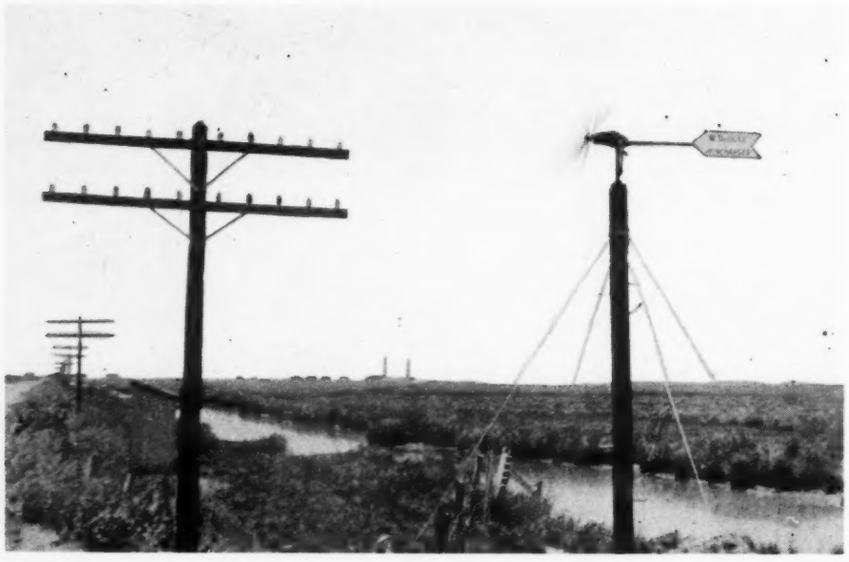


The first wind-driven unit installed by the Houston Pipe Line Company

By
DAVE HARRELL
Corrosion Engineer,
Houston Pipe Line Company

Operation of Cathodic Protection Units on High-Pressure Gas Lines[1]

Results obtained by one company indicate electrical protection is practicable, efficient, and economical on gas lines, coated or uncoated, if continuously maintained

NEARLY every new device that is introduced on a pipe line is given a name such as only pipeliners can evolve and it was not until just the other day that I heard cathodic protection units referred to as "rust pumps."

So far as we know there are only three practical sources of power for the application of direct currents to pipe lines to protect them electrically. These are: rectified alternating current from the power mains, a prime mover driving a d-c. generator, and some form of battery.

The Houston Pipe Line Company has been applying cathodic protection to its pipe lines since 1934. At the present time it is possible to say that it is believed several systems have been developed that are successful. The most outstanding of these is a gas engine driven unit that has been in operation since 1935 and is still operating satisfactorily. During this period it has operated 97 percent of the time and has successfully protected a one-mile section of 16-in. pipe that has such a bad coating job that it could almost be considered bare line. In total, the following types of units are in operation on the company's system, each of which will be described briefly.

1. Rectifier unit from main power-line
2. Motor-generator set
3. Gas-engine driven generator
4. Wind-powered unit, using storage battery
5. Rotary gas-driven engine driving generator

There are many rectifier units in operation in various parts of the country and they certainly constitute the most trouble-free operation of any type of unit. They consist simply of a secondary transformer and the rectifier unit mounted on a pole and connected through a meter to the main line of the power company. It is not believed that these units are practicable on bare lines of large diameter, but many installations are doing a fine job of protecting coated lines. The usual size is about 25 amp. but some units of larger capacity have been constructed. The usual power rate for service to a small unit like this is about 2 cents per kw-hr. The units are only 50 percent efficient over a long period of time so that the effective rate is about 4 cents per kw-hr.

Motor-generator sets are in about the same category as rectifier units except

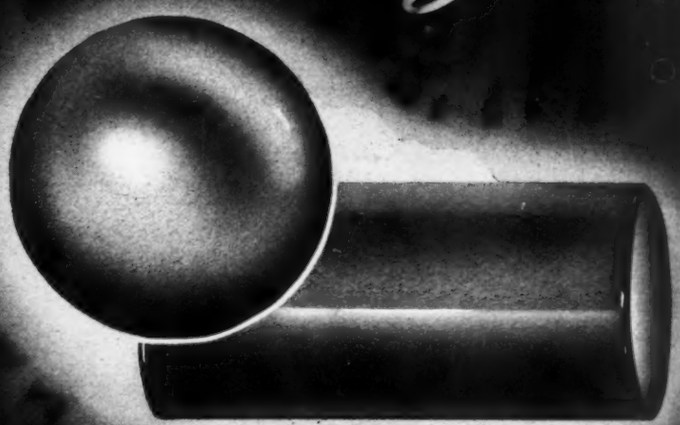
[1]Paper presented at Oil-World Exposition, Houston, Texas, April 25, 1939.

DAVE HARRELL

studied electrical engineering at Yale and Texas universities, receiving a bachelor's degree from the latter in 1923—After graduation he spent three years in Colombia, South America, with the Tropical Oil Company, doing geological and engineering work—He returned to the United States at the end of that period to become affiliated with the geophysical department of the Humble Oil and Refining Company—His next connection was with the Reed Roller Bit Company, Houston, and when he left that company after two years to become associated with the Houston Natural Gas Company he was in charge of sales for the core bit department—He remained with the Houston Natural three years, joining the staff of the Houston Pipe Line Company in 1933.

STRONGER BEARINGS

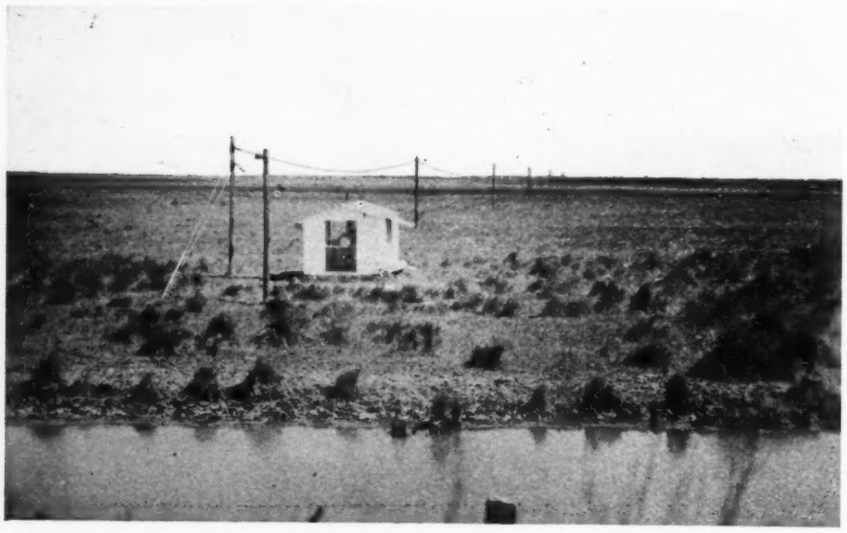
YOUR *Guarantee* THAT HUGHES ROCK BITS ARE *Stronger!*



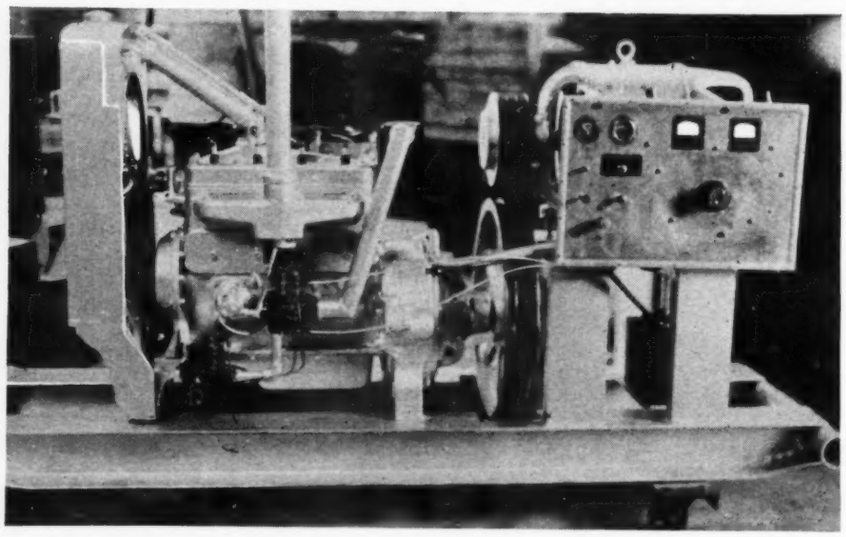
Hughes Rock Bit Roller and Ball Bearings are made of the highest "shock resisting" steel known . . . they are heat-treated in special enclosed retort furnaces . . . they combine the maximum qualities of wear resistance, toughness and strength.

HUGHES TOOL COMPANY - HOUSTON, TEXAS

A short feeder system and 12¾-in. junk-pipe ground bed in soil of high resistance. The pipe is buried 21 ft. vertically



This unit has been in operation two years without major repairs. The feeder system is constructed from old drilling cable



A 200-amp., 40-volt cathodic protection unit driven by a gas engine. The unit has complete automatic protective devices

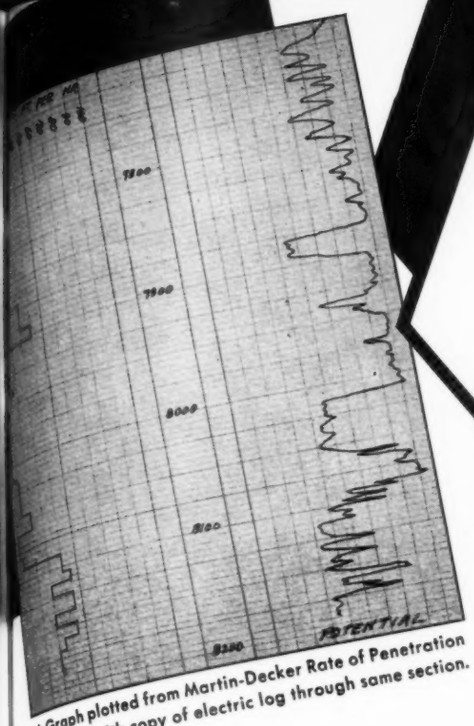
that they require more attention as they have to be lubricated periodically, the brushes on the generator have to be adjusted, and the commutator kept clean. The efficiency is about the same as they are powered by induction motors that have a power factor of about 0.6 and the d-c. generators seldom have an efficiency greater than 80 percent. Considerably more power output can be obtained using these units. When a large oil company has its own power station, as at a refinery or pump station, it certainly appears to be good business to run transmission lines and supply either motor-generator or rectifier units with the necessary a-c. to operate. Several of the larger oil companies have already built such transmission lines from their refineries and have them in operation.

The first cathodic protection installation by our company in 1934 was powered by a "wincharger," which is nothing more or less than a windmill. This generator was operated for a period of a year on a section of coated line a mile in length. Then the 1200-ft. section at one end of this coated section went bad and the windmill was replaced by a gas-engine-driven generator that could supply ample power. Many windmills are still in operation on coated lines and a combination wind-driven and storage battery unit has been developed that is really proving excellent for this purpose.

When I think of something for nothing I automatically think of a unit we have installed at Hoskins Mound, Texas. We supply the Freeport Sulphur Company's plant at Hoskins with gas served through two 12¾-in. regulators in 24 hr. service. Only one of the 12¾-in. lines is in service at any one time and the other is a standby. One of these regulators was bypassed and a portion of the gas was used to drive a rotary engine. This unit has been delivering an average of 50 amp. at 20 volts. This year it was out of service only one day while the governor was replaced. It is protecting about 1000 ft. of 16-in. pipe through the yard of the sulphur company's plant where a very bad corrosive condition exists.

On lines virtually devoid of any coating it has been impossible to reduce the current per sq. ft. of exposed pipe below about 0.004 amp. Most of the lines are either 16 in. or 18 in. so that current densities of from 17 to 19 milliamperes per lineal ft. must be supplied, or about 100 amp. per mile of protected section. Quite often a total of 150 to 170 amp. is required when more than a mile of line is included in

LOG YOUR FORMATIONS *As you drill them*



A Graph plotted from Martin-Decker Rate of Penetration Recorder with copy of electric log through same section.

With...

The Martin-Decker Automatic Rate of Penetration Recorder

The Martin-Decker Rate of Penetration Recorder does your "Time Drilling Logging" for you...*automatically,* with no guesswork. It eliminates the human element. A continuous record of the rate at which the bit penetrates the formation shows the formation breaks. These breaks, plotted in graph form, are the picture of the formations drilled.

Obviously, such data is invaluable. Invaluable for correlation purposes... for bit (and other equipment) studies... and as a supplement to your electrical log. It aids in deciding your coring program. In territories where production is obtained from lime formations, time drilling is the approved method of logging.

And, with "Time Drilling Logging" now available *automatically* and *continuously* with the Martin-Decker Rate of Penetration Recorder, it is more dependable and more valuable than ever before—*because it is accurate!*

Write for Descriptive Literature

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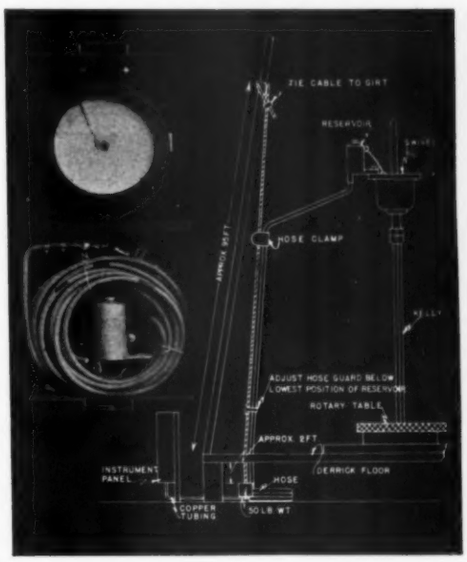


The schematic drawing shows method of installation and the photograph shows the instrument as shipped.

The Martin-Decker Automatic Rate of Penetration Recorder

... consists of three simple parts—a water reservoir attached to the swivel, a length of hose, and an especially built low-range pressure recorder equipped with 8 or 24 hour clock and charts, as desired. The system is filled with clear water and an anti-freeze solution is used in cold weather. In operation, the pressure recorder simply measures the rate of change of hydrostatic pressure in the system as the kelly lowers while drilling. Change in angle of the record indicates different rates of penetration —the key to formation changes. It's simple, fool-proof, *positive!*

Recording vacuum tube voltmeter used to draw negative decline curve when wind-driven generator stops

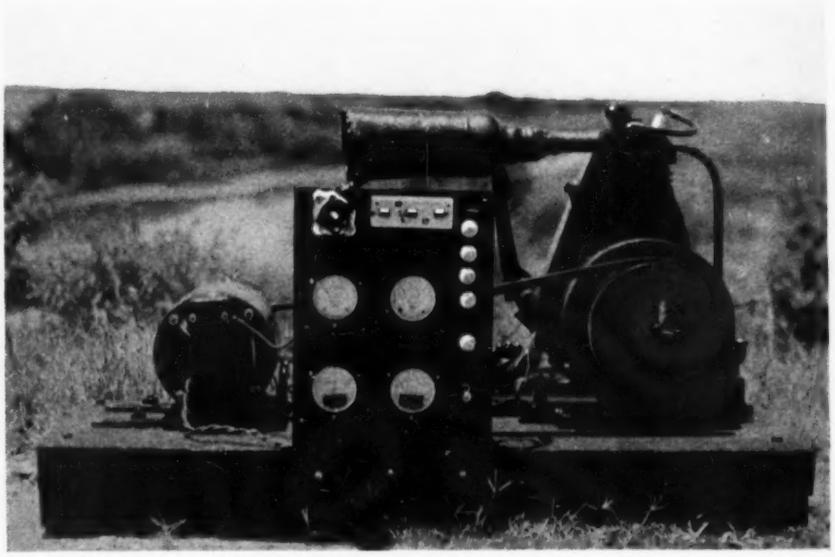
the protected section, as at river crossings, etc. Due to the necessity of placing anodes at a remote location from poorly coated lines, in order to get the spread or fan of current to the extremities of the protected section, enough voltage must be available to overcome the ground resistance that is necessarily high. It averages about 40 volts on most of these large installations. This means that powers of from 4 to 10 kw. per unit must be employed to maintain protection of these long sections of almost bare line. At one point a current of 1200 amp. is being applied to approximately 15 miles of affected pipe.

In direct contrast to this, protection is maintained on well-coated pipe using current as low as 0.1 milliampere per sq. ft. and power of 60 watts per mile of pipe. Obviously, the power company cannot extend its lines very far for a 60-watt load nor can it supply at a very economical figure a 100-kw. load scattered over a wide area.

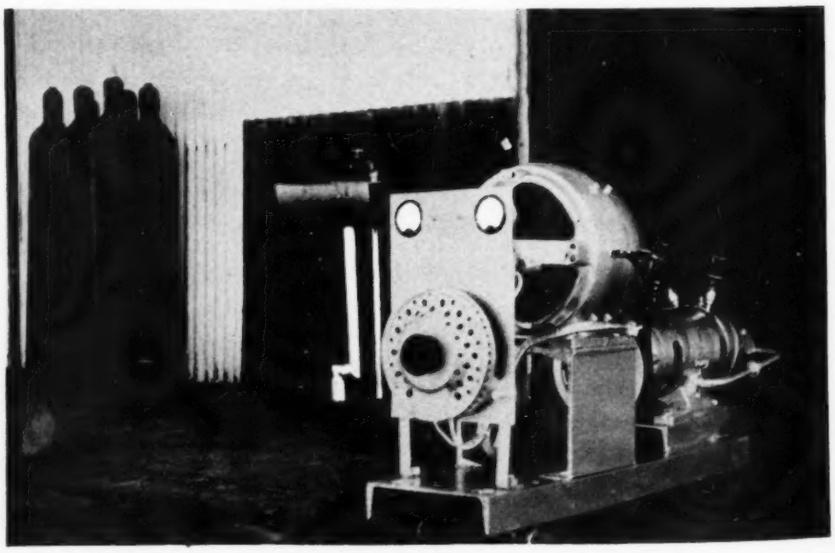
Concerning methods of checking the results of these installations, the best test is the periodic survey to measure the ground potential with the vacuum-tube voltmeter. This is an extremely high resistance instrument for measuring as low as 10 mv. with great accuracy. By experiment it has been established that the potential drop from soil to pipe of about 0.24 volt is sufficient to prevent iron from leaving the line as a soluble salt. To substantiate this coupons were attached to the line and their loss in weight was measured. It was found that they did not lose any appreciable weight in corrosive areas so long as this minimum protective potential was maintained. As a factor of safety it has been the practice to maintain the pipe potential at least 0.3 volt negative below that of the soil in all locations protected cathodically. If the gas leak record of well-coated lines to which cathodic protection has been applied were depended upon to give any indication of the efficiency of cathodic protection, it might be years before any results could be observed.

All the results seem to indicate that electrical protection is practicable, efficient, and economical on gas mains, coated or uncoated, *but* it must be continuously maintained. If allowed to slump the leaks show up again and the progressive leak curve will follow its original course unless protection is reinstated on the section involved.

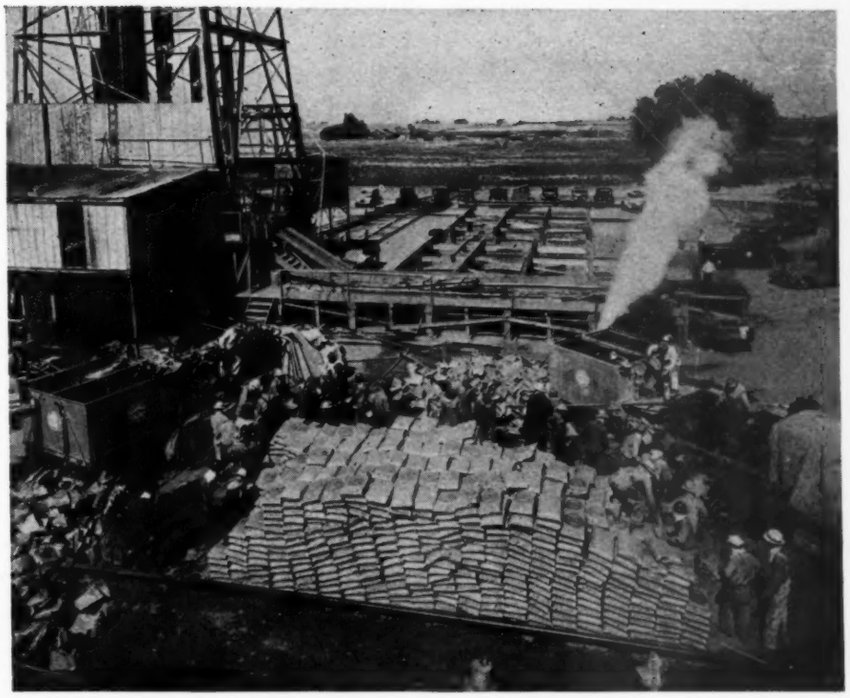
A test unit for measuring ground bed resistance, installed in 1934; 500 watts, a-c., d-c.



Shop view of cathodic protection unit driven by a rotary engine. This unit produces 60 amp. at 40 volts



Cementing the 7⅝-in. water string in No. 1 Fink at a depth of 11,350 ft. using 2500 sacks of Victor oil well cement



A PETROLEUM ENGINEER EXCLUSIVE FEATURE

By
WALLACE A. SAWDON
Pacific Coast and Foreign Editor

Large Drilling Equipment Tested on Two Wells in California

Far-sighted California operators subject equipment designed for drilling to 18,000 to 20,000-ft. depths to rigid tests in two 11,500-ft. holes

CONSIDERABLE interest has been focused on the heavy equipment powered by 500-lb. steam employed in the "super" rig used by Superior Oil Company at the Rio Bravo field in California. Other equipment of the most modern design employed in connection with this heavy equipment has shown its adaptability in complementing the operation of the largest machinery ever used in drilling an oil well. That this equipment is capable of drilling efficiently to the greatest depths now considered practicable has been more or less assured by the performance of the super rig in drilling two wells. The drilling of these wells was not a test of the full capacity of the equipment but it did provide data to indicate how effective the equipment will be when depths of 18,000 to 20,000 ft. become necessary.

The two wells drilled were No. 1 Moodie and No. 1 Fink. In both wells rock bits were used from the surface to total depth below 11,000 ft. Although no speed records were attempted, the rate of drilling was rapid as indicated by the fact that in one well more than 7000 ft. of 12¼-in. hole was drilled in eight days. Total elapsed time from spudding to production in the Fink well was only 57 days and this included running of liner and tubing.

There was a slight difference in the drilling and completion programs followed in putting down the two wells. In the Moodie well 17½-in. hole was drilled to 1800 ft., 12¼-in. hole to 8789 ft., and 11-in. hole to 11,528 ft. where 7⅝-in. casing was landed and cemented. The hole was cored from that depth to the total depth of 11,550 ft., at which the well was brought-in without liner, or "barefoot." In No. 1 Fink 17½-in. hole was drilled to 1532 ft., and 11-in. hole to 11,412 ft. The 7⅝-in. casing was landed and cemented at 11,350 ft. The cement was drilled-out and the hole carried to a total depth of 11,445 ft. using a 6⅝-in. bit. A 120-ft. string of 5¾-in. liner, of which 100 ft. were perforated, was set on bottom and the well completed using 2½-in. tubing bottomed at 10,507 ft. Each well came in having an estimated initial production of approximately 3000 bbl. per day.

In drilling these wells rotating speeds ranged from 450 r.p.m. at the top to 200 r.p.m. at the bottom of the 11-in. holes. Long drill collars were used to concentrate the weight directly above the bit and to allow the drill pipe itself to be held in tension. This enabled the efficient use of high rotating speeds and the maintenance of a vertical hole. In the Fink well, for example, four to six drill collars, each 60 ft. in length, were used variously from 3000 ft. to 10,000 ft. From 10,000 ft. to bottom, two 60-ft. drill collars were employed. A full-hole reamer made-up between the drill collars and the bit was used in drilling the entire depth.

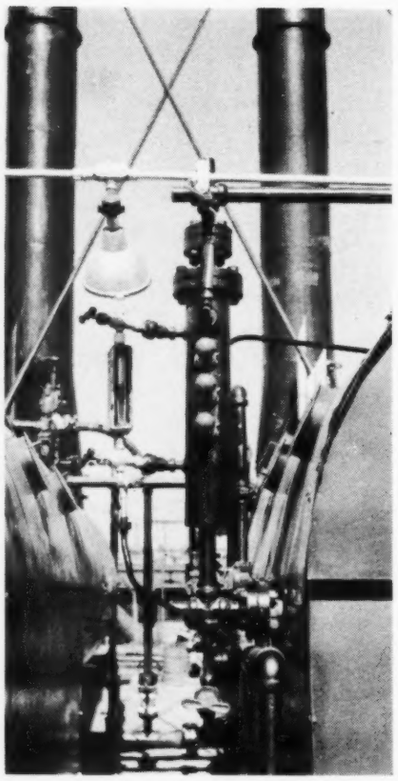
The weight carried, controlled continuously by use of a weight indicator, was held at from 16,000 to 25,000 lb., depending upon rotating speed, formations being drilled, and other pertinent factors. Rotating speed was regulated by use of an indicating tachometer registering the r.p.m. on the instrument dial on which were also indicated the weight, torque, and mud pressure. Controlled vertical drilling was practiced throughout the drilling of the well and a drift recorder was run periodically to check the angle from vertical so that immediate cor-

rective measures could be taken if the hole tended to deviate.

For drilling from the shoe of the surface string to bottom, the same string of 4½-in. high-alloy drill pipe was used in both wells. Particular attention was paid to the performance of this drill pipe; and with the mileage obtained in the two wells it is believed that its adaptability for deep drilling at high rotating speed has been demonstrated provided the proper amount of weight is applied just above the bit. The only indication of wear was a slight abrasion of the pipe by pieces of metal in the hole. The one set of tool joints, used in both wells, also stood up under the extended service most satisfactorily.

The mud was kept in condition at all times at an average weight of 80 lb. per cu. ft. Baroid was used to provide weight when necessary and the chemicals introduced when needed included sodium tetrophosphate and Quebracho. Mud fluid as mixed was pumped into a storage tank in which the contents were prevented from stratifying by a mud-mixing gun and, at the bottom of the tank, by a whirling discharge obtained by centrifugal force actuating four nozzles.

To obtain maximum benefit from the capacity of the two large slush pumps, a 5-in. steel rotary hose was used. This hose, 55 ft. in length, is the only one of its size ever assembled and has a full 5-in. I.D. through swivels as well as through pipe. Using such large pumps the velocity through a smaller hose would probably have resulted in a severe abrasive action. After the first well (the No. 1 Moodie) was completed the hose was inspected in the shop but no evidence of wear could be detected.



Each Broderick boiler, fired by a Sonner burner, has a water column, as shown, equipped with an Inferno Reflex gauge and gauge cocks, and a Reliance low-water alarm

Considerable importance was attached by Superior Oil Company to the cementing of the water string. This job probably set up a speed record for cementing operations but the speed was desired only because it was believed a necessary factor in a successful cementing operation. The company believes that the cement should be placed behind the casing as soon as humanly possible after the slurry is mixed; and when longer strings are to be cemented at depths where high bottom-hole temperatures must be expected, facilities for putting the cement behind the pipe quickly should be available. The ample capacity of the two 15½-in. by 9¼-in. by 22-in. pumps powered by 500-lb. steam used with the super rig demonstrated that pumps of this size are capable of displacing the cement rapidly at depths below 11,000 ft.

Five boilers generating steam at 500-lb. pressure were in service on the Rio Bravo wells. Four of these boilers would have been adequate for the drilling operations but the fifth was used to test the efficiency of the larger steam generating plant and pumps in performing a much more difficult job when the necessity arises.

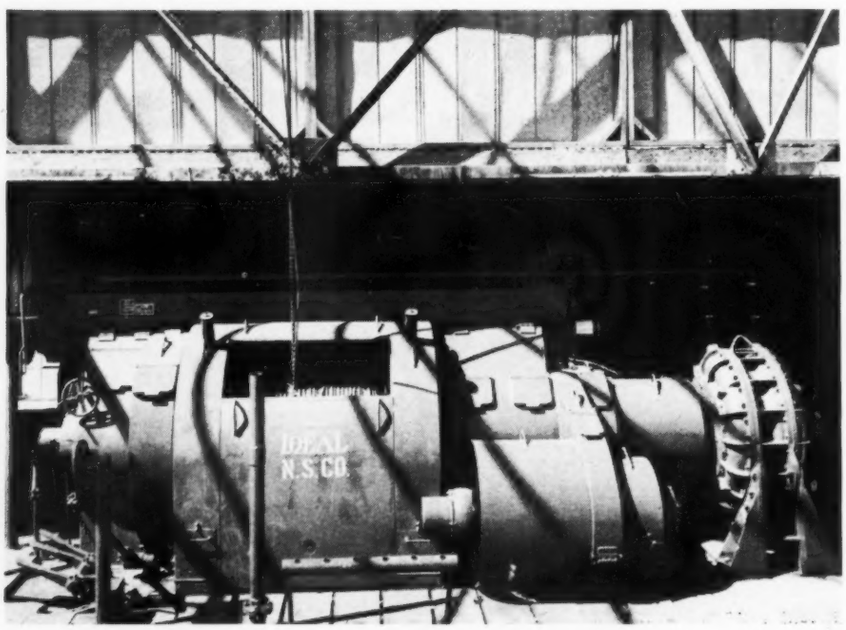
The water string in No. 1 Moodie was 7⅝-in. Extreme Line casing and was cemented at a depth of 11,528 ft. It was made-up having a float shoe on the lower end and two float collars situated in each of the two joints just above the shoe. The bottom-hole temperature was 250° F. Two cementing trucks were used, each having a pump the steam end of which is designed for 350- and 500-lb. pressure, respectively. After the cement was mixed and the upper plug placed, the two mud pumps were connected and the cement displaced by these pumps in parallel.

The mixing time for the 2500 sacks of cement used on this job was 40 minutes. The displacement time using the large pumps was only 14 minutes and passage of the cement through the shoe and collars during displacement was at the rate of 1380 gal. per minute. The initial pressure was 500 lb. and final pressure 2200 lb. per sq. in.

The speed of displacement is believed by the company to aid materially in reducing the hazard of channeling. As another precaution against channeling the casing is raised and lowered continously a distance of 10 ft. during the entire cementing operation.

Equipment—Its Performance and Adaptability to Deep Drilling

The special equipment used in assembling the super rig was quite evidently designed for heavier duty than that required by the present Rio Bravo development work because the Superior and other companies are drilling wells



National drawworks and accessory equipment including Parkersburg Hydromatic brake and Foster Hi-Speed automatic cathead and catline hoist

AFTER MANY YEARS of intensive research, in close cooperation with petroleum engineers and cementing companies, the perfected VICTOR and EL TORO CEMENTS are successfully meeting all the exacting requirements of modern oil well cementing.

Your inquiry for proof, recommendations or prices will receive prompt and careful attention.

SOUTHWESTERN PORTLAND CEMENT CO., *Los Angeles • El Paso*

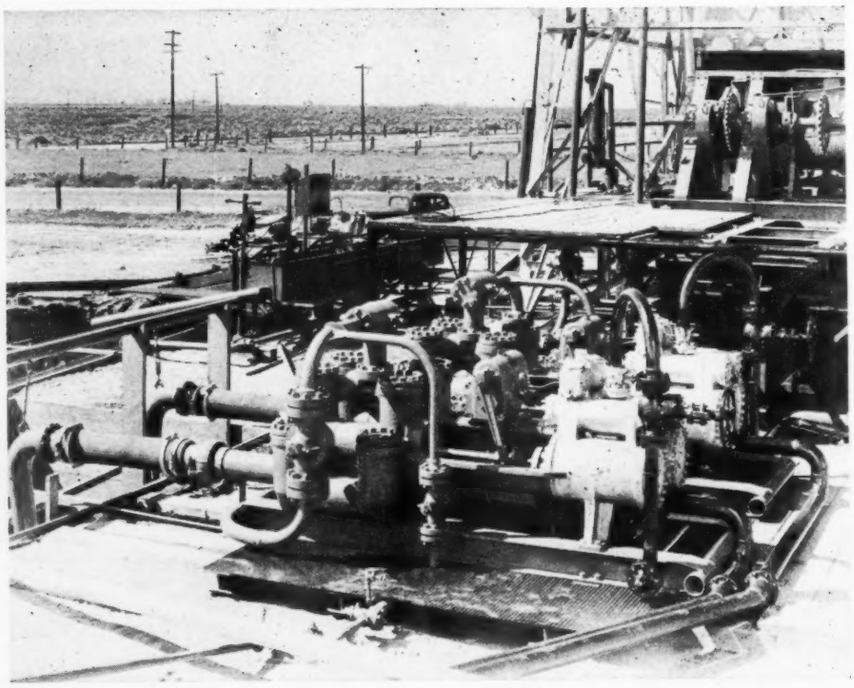
SOUTHWESTERN PORTLAND CEMENT CO. TRADE VICTOR MARK LOS ANGELES, CAL.

VICTOR and EL TORO

"OIL WELL" • "HIGH TEMPERATURE"
"HIGH EARLY" • "SULPHATE RESISTANT"

CEMENTS

SOUTHWESTERN PORTLAND CEMENT CO. EL TORO BRAND EL PASO, TEX.



National's two Ideal 15½-in. by 9¼-in. by 22-in. slush pumps operating at a steam pressure of 500 lb. Baroid was used to provide weight to the drilling mud

in that field satisfactorily using lighter equipment. This trial, however, offers an excellent opportunity for observing equipment performance and for gauging the adaptability of both the special and the other more or less standard, but improved, heavy equipment used. In these wells 500-lb. steam has been used in well-drilling operations for the first time and although all of the steam-powered equipment does not utilize steam at 500 lb., its application has now been tested.

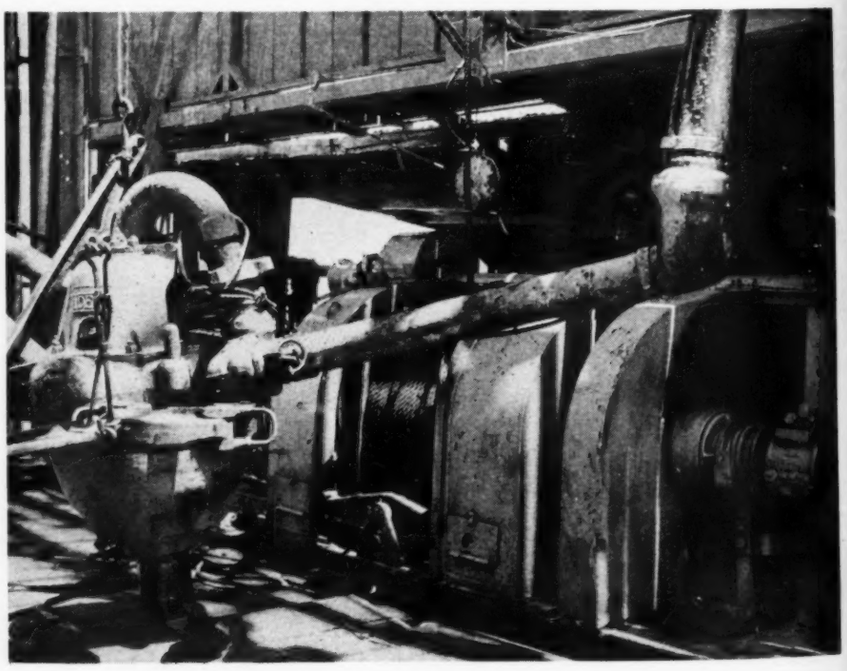
The only change contemplated of heavier equipment in the super rig is a drawworks, crown block, and traveling block that will permit the use of 1½-in. wire line instead of the 1¼-in., which is the largest size used to date. Not only the strength but also the life of the line is being considered when contemplating the greater diameter line. There is, however, the possibility of developing a stronger and more flexible alloy line that will obviate the larger size. This would then eliminate the necessity for designing a drawworks and larger-sheaved blocks to take care of 1½-in. line.

A higher derrick has also been considered but the so-called 178-ft. derrick (which is actually 175 ft. from the derrick floor to the bottom of the water table beams) having a 32-ft. base appears at present to offer the best advantages when all factors are considered. This derrick speeds-up round trips considerably after reaching a depth of 10,000 ft. Derricks on both wells were supplied by Steel Oil Derrick Company and have a 1,000,000-lb. (500-ton) load capacity in the tower. The steel substructure permits the table to sustain a load of 500,000 lb. (250 ton) and in each of the three pipe set-backs there is a load capacity of 250,000 lb. (125 ton).

The derricks had been moved from other locations but reinforced especially for the heavier work. In the derrick used on the Fink well, the extended legs, which had served to elevate the derrick floor 8 ft. above the ground, were lengthened by removing the bottom angles of the legs and replacing them by longer ones to increase the height of derrick floor to 11 ft. above the ground. This additional height aids in getting flooded suction for the pumps. The steel substructures for the drawworks and its engine and for the standby hoist and engine unit were also raised 3 ft. by the addition of steel members on the bottom.

The 15-in. by 14-in. engine used to power the drawworks was an Ideal-Ajax twin-cylinder engine of the piston-valve type equipped with roller bearings and having a built-in chain guard. At 250 r.p.m. powered by 500-lb. steam this engine is rated at 1950 hp. A particular advantage provided is the high torque at low speed.

Similar in design to the 14-in. by 14-in. unit, this engine has a box-type frame with reinforced cylinder end and extra-heavy ribbing. Special flanges have been built to which a sheet-steel sprocket guard is bolted. The reverse control mechanism is redesigned to make it more rigid and adjustable to different drawworks. The diameter of the crankshaft is 8½ in. in the main bearing. The sprocket is of cast-steel but is shrunk and keyed to the shaft. The sprocket rim is bolted to the hub and has 38 teeth for two double chains



Connection of Chiksan steel rotary hose to swivel is plainly shown. The swivel is on the kelly, which is standing in the rat-hole while drill pipe is being pulled

CHECK YOUR DRILLING STRING ALIGNMENT AND AVOID FAILURES

Unexplainable drilling string failures have been a major oil field problem. Believing these failures were caused by misalignment in the drilling string—misalignment not perceptible to the naked eye—The National Supply Co. developed the Alignascope, an instrument for checking the straightness of the string. In actual use this instrument proved to be of inestimable value in detecting imperceptible bends in the kelly, drill pipe, tool joints and drill collars.

The IDEAL ALIGNASCOPE can be easily used by members of the regular drilling crew while the section to be checked is suspended in the derrick.

National strongly recommends that you check the straightness of your drilling string with the IDEAL ALIGNASCOPE and avoid the worry and costly results of misalignment, such as—

SWIVEL—Overheating and "locking" of the swivel due to an imperceptible bend in the upper portion of the kelly.

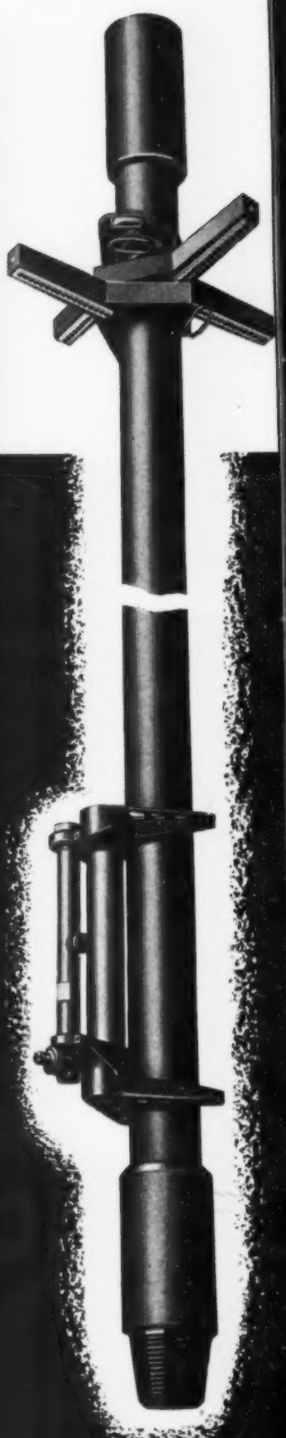
KELLY—Serious kinking of the drill pipe due to a small bend in the lower portion of the kelly.

DRILL PIPE—Drill pipe failures due to repeated stressing caused by imperceptible bends in the pipe.

TOOL JOINTS—Joint failure due to misaligned tool joint threads. Incipient galling and washed-out tapered joints caused by the joints backing off as a result of slight kinks in the drill pipe or drill collars.

DRILL COLLARS—Joint troubles due to crooked drill collars, or to collars being out of line with each other.

Ask for Alignascope Bulletin No. 205



Alignascope in Position for Checking Drill Pipe.

NATIONAL

THE NATIONAL SUPPLY COMPANY

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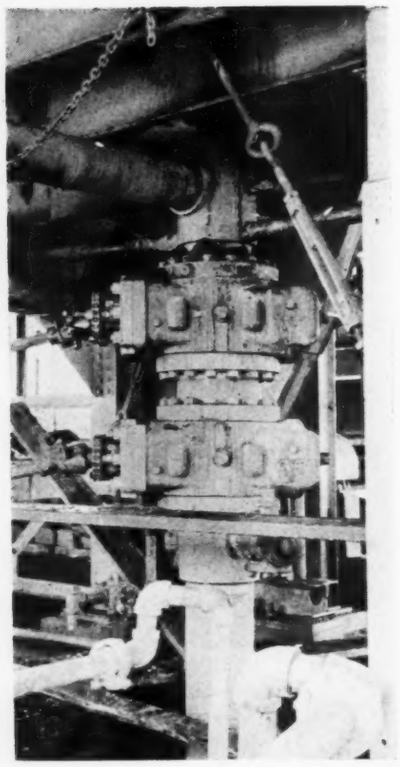


Two Shaffer control gates having remote control were installed

having a 3⅛-in. pitch. Crankshaft and crankpin bearings are specially designed Timken roller bearings. The overall length of the engine is 132 in. and the overall width 91 in.

The drawworks is an Ideal No. 23-10½-FE having a higher speed ratio than in the standard unit and driven by two 3⅛-in. pitch double chains. This drawworks is of the totally-enclosed, 3-speed type having 10½-in. drumshaft and 9-in. lineshaft. The drum capacity for 1¼-in. line is 4690 ft.

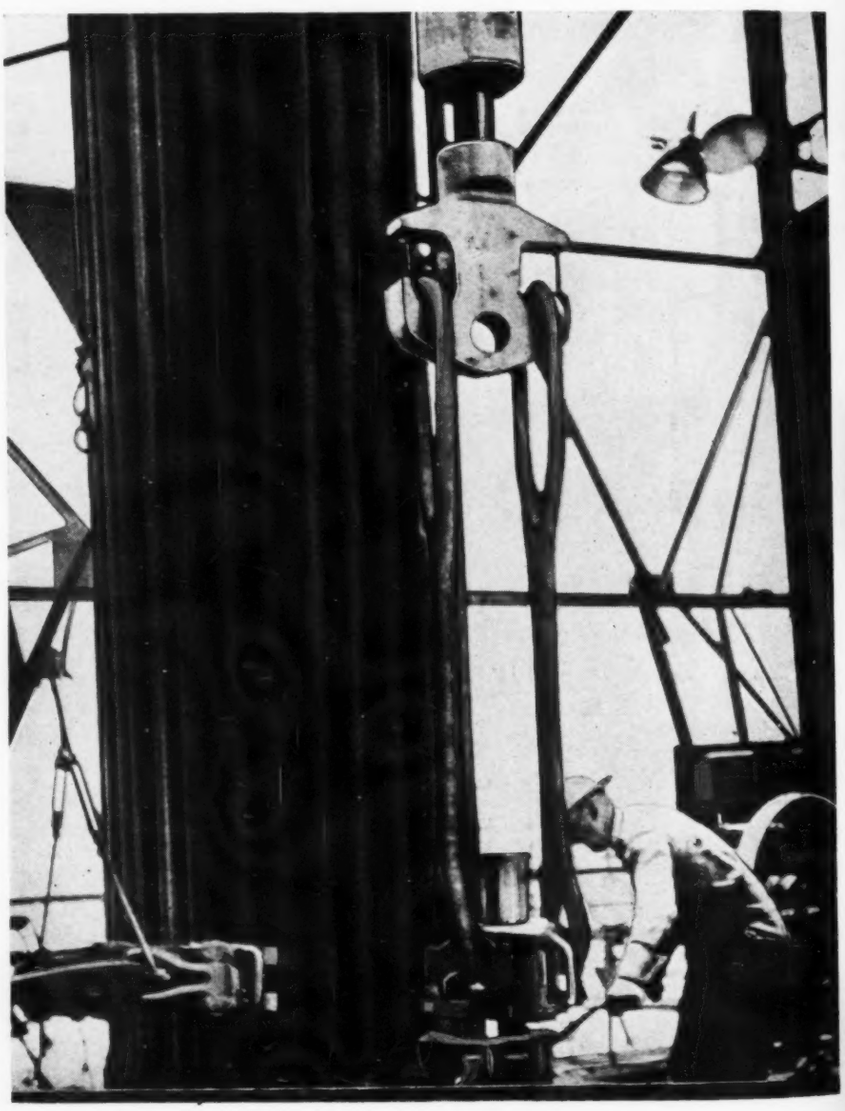
Using this large equipment it was found that the heavy drill string could be pulled out of the hole at greater speed. For instance, using eight lines, 6000 ft. of the heavy 4½-in. drill pipe could be pulled in high and 13,000 ft. in second; however, low was used at times to start the load off bottom. It must be remembered that in addition to the weight of the drill-pipe string, which averaged approximately 22 lb. per ft. including tool joints, the string also included the long drill collars. This indicates the considerable reserve that is available for future deeper drilling.

The Parkersburg Hydromatic brake with which the drawworks was equipped is a 40-in. double-rotor type in separate cradle independent of any support on shaft with only torque from brake to shaft. A Foster Hi-Speed automatic cathead and catline hoist provided maximum facilities for breaking joints and for handling heavy objects about the derrick floor. The clutch on this equipment is mechanically engaged and never can be partly engaged regardless of lineshaft speed.

The rotary table was driven by an Ideal underfloor direct rotary drive, Type "BC." The engine powering the drive was an Ideal-Ajax 12-in. by 12-in. twin-cylinder engine placed beneath the derrick floor and direct-connected with 3⅛-in. pitch, double chain to a 6-in. jackshaft carrying the clutch sprocket for direct drive to the rotary machine. The engine was mounted on a skid base that bolts in turn to the base on which the two pedestals supporting the extension shaft are mounted. The chain drive was fully enclosed.

The important function of the rotary machine when high rotating speeds are used is significant because of the trend to higher speeds in deeper drilling. An individual drive for the table must necessarily be used under these conditions both from an economical and efficiency standpoint. The table used with the super rig was an Ideal HS-20¼ equipped with spiral gears that provided smooth and quiet operation. By overlapping action the load is transferred from tooth to tooth without shocks or sudden changes of tooth pressure. The table gear has 69 teeth and the pinion 25 teeth.

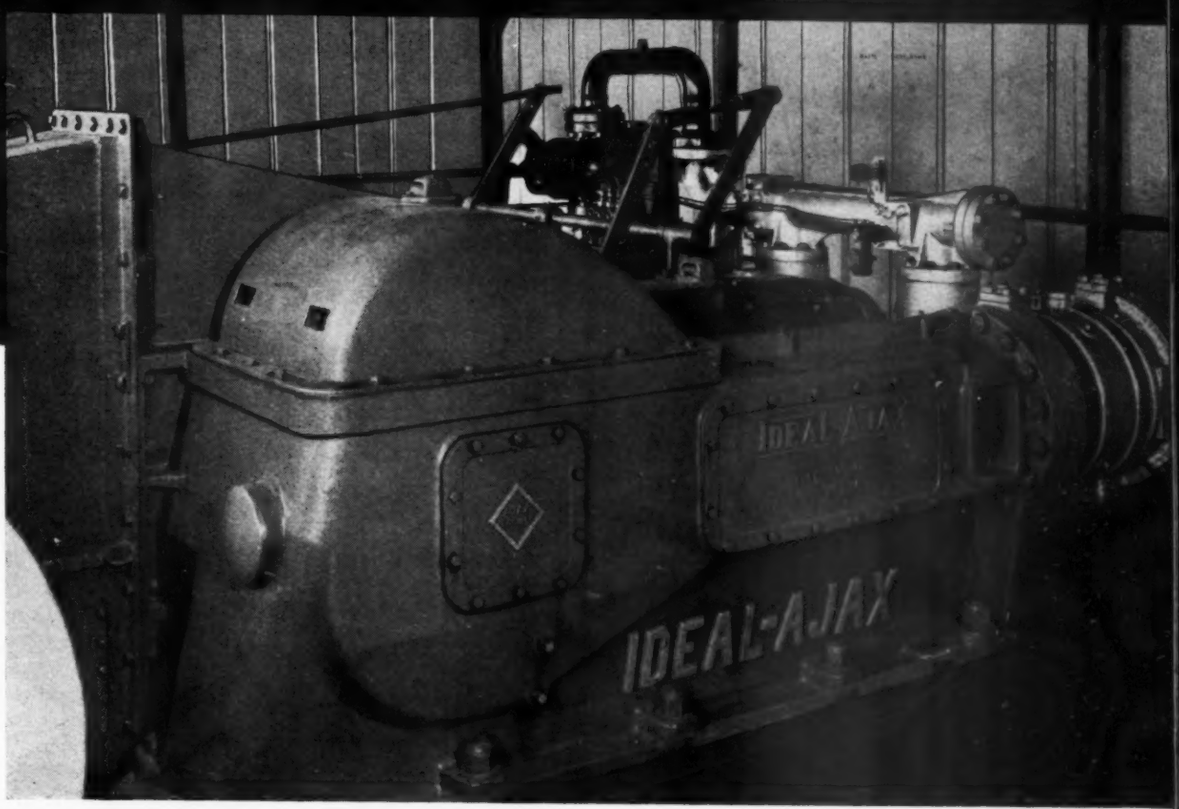
The Chiksan 5-in. high-pressure steel circulating hose having full 5-in. I.D. throughout is 55 ft. in length, made up of seven joints and 17 swivels. The swivels are of cast-steel with ball races flame-hardened. The steel in the balls and races has a Rockwell hardness of 55-56 and this feature eliminates the races rolling or flattening out and in turn keeps the



Pulling a string of Spang Chalfant drill pipe

7,000 FEET OF HOLE IN 8 DAYS

naturally an AJAX drilled it!



This amazing record made by the drilling crews of Superior Oil Company's Moody No. 1 at Rio Bravo was accomplished with the aid of the largest, heaviest and fastest equipment ever employed. The giant Ajax 15x14 illustrated performed to perfection under a working steam pressure of 500 pounds.

IDEAL-AJAX 15x14 ENGINE

World's Largest, Most Powerful Steam Drilling Engine!

The trend to deeper holes and faster drilling is based on the superb performance of the equipment available to modern operators—and when it comes to selecting the prime movers, they always come to AJAX . . . proving once again that Ajax is headquarters of the industry and that *there's nothing like Steam for dependable power.* Ajax has the unrivalled experience, Ajax has the engineering *know-how*, Ajax uses the materials and craftsmanship that make IDEAL-AJAX first to be thought of when tough jobs are faced . . . first in the stamina, dependability, controlled power and speed that deliver the goods.

For more than sixty years, Ajax has been developing the unequalled qualities of *steam* drilling engines—and holds more world's records for performance than any other builder of any kind of oil field engine. See your National Supply man for the facts on the right type and size of Ideal-Ajax engine for *your* particular jobs!

AJAX ENGINES

Manufactured Exclusively by

AJAX IRON WORKS
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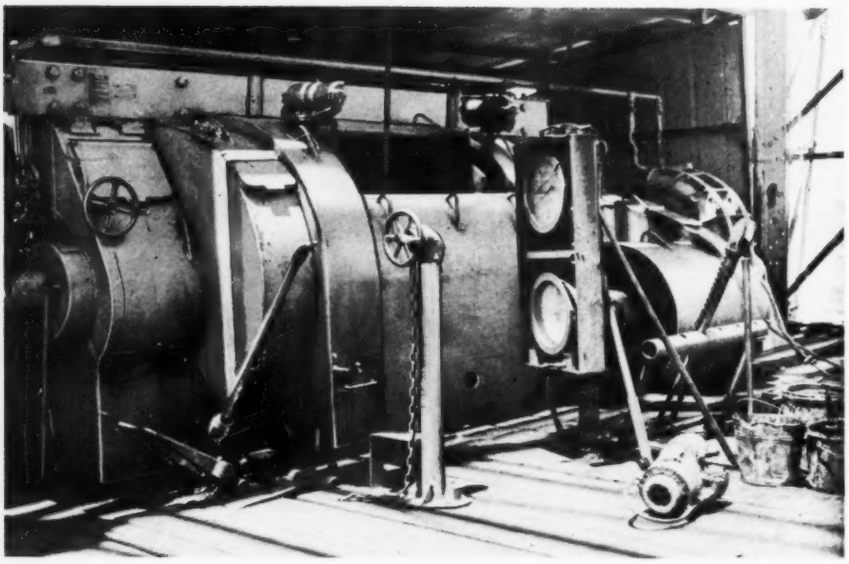
THE NATIONAL SUPPLY COMPANIES IN EVERY FIELD

AJAX ENGINES



A Martin-Decker "Quintuplex" provided for control of weight carried on bit, speed of rotation, torque, and mud-pump pressure

packing chamber at correct size and prevents leaks. All machined parts are held to a 0.003 tolerance. The flexibility of the hose and the ease with which it "collapses" when the kelly is in the rat-hole can be seen in an accompanying illustration. The hose used in drilling the two Rio Bravo wells had the wing-nut connection to the swivel built-in as part of the hose and the reduction down to 4-in. diameter was made to provide venturi action in the flow. The entire design was aimed to eliminate turbulence and thus reduce cutting action to the minimum.

The swivel was an Ideal 300-ton Type M having a 4-in. fluid passage. Other National equipment in the derrick included the unitized standby drawworks driven by a 12-in. by 12-in. twin engine, a Type 648-T crown block having six 48-in. sheaves, a Type 548-T 88-in. traveling block having five 48-in. sheaves, a 300-ton Type DA-30 connector, and an octagonal kelly.

A Martin-Decker "Quintuplex" provided for control of weight carried on the bit, speed of rotation, torque, and mud-pump pressure. The elevators and tongs were manufactured by Byron Jackson. Both Pacific and Roebling 1¼-in. wire line was used. The Garrott bug blower was designed especially for 500-lb. steam for use on this rig. A Chiksan All-Steel circulating head was available on the derrick floor for use when needed.

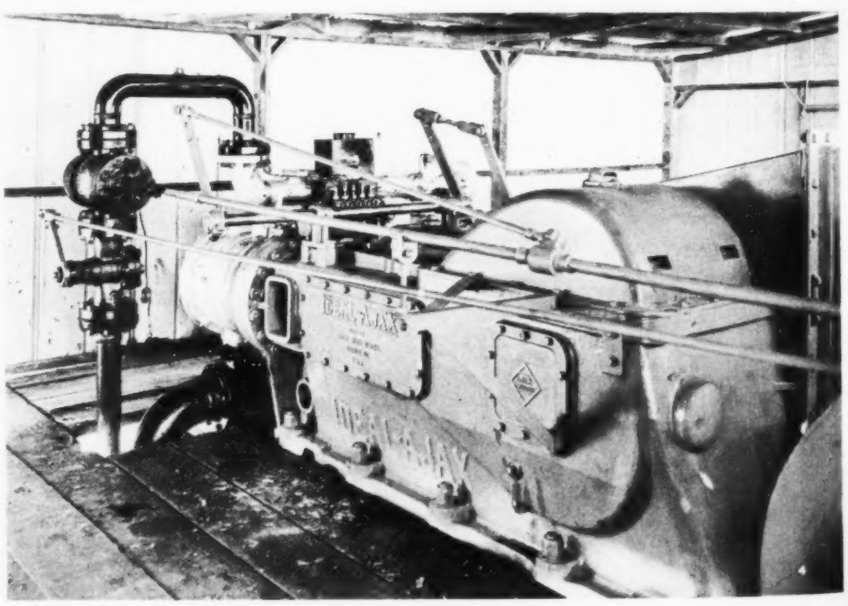
Both Hughes and Reed rock bits were employed in drilling the two wells by the super rig. The 6⅝-in. drill pipe used in drilling with 17½-in. bits was Spang Chalfant as was also the 4½-in. high-alloy drill pipe used for drilling from the bottom of the surface string to total depth of each well. The tool joints and drill collar were supplied by National. An Ideal Alignascope was used at times to check drill collars and drill pipe. This instrument has been found of great value in maintaining proper condition of equipment in the hole on deep drilling.

Between the bits and drill collar was a Reed full-hole reamer. Two Shaffer control gates having remote control were installed. Periodic readings to check straightness of the hole were made with a Totco drift recorder.

All casing was Spang Chalfant Extreme Line. The surface strings were 13⅜ in. and equipped with Baker guide shoes. The 7⅝-in. strings were made-up with a Baker float shoe and two Baker float collars in each. This floating equipment provided for floating-in the long strings of casing and then maintained pressure on the cement after it was placed by means of the ball-type back-pressure valves in the float shoes and float collars. The high velocity of the 2500 sacks of cement passing through the shoes and collars during displacement evidently had no effect on the internal construction as the back-pressure valves effectively prevented return of cement into the casing as soon as the plugs bumped. The cementing job was done by the Pacific Oil Well Cementing Company using Victor oil well cement.

Of particular interest to operators are the two mud pumps used. These were Ideal 15½-in. by 9¼-in. by 22-in. steam slush pumps operating at a steam pressure of 500 lb. per sq. in. The bore of the largest water cylinder is 9¼ in. and that of the smaller liners is 8½ in., 7¾ in., or 7 in. In drilling the Moodie and Fink wells, 9¼-in. liners were used predominantly; none was used smaller than 8½ in. The maximum recommended water pressure for the pump is 3750 lb. per sq. in. and the normal speed is 45 s.p.m. Displacement using the 9¼-in. liner at a pump speed of 60 s.p.m. is 1450 gal. per minute. The diameter of the piston rod is 3⅛ in. The suction pipe connection is 10 in., discharge pipe connection 4 in., steam inlet 4 in., and steam exhaust 6 in. The length of the pump base is 144 in. and the width 77½ in.

During the drilling of the two wells the two pumps were compounded for



This 15-in. by 14-in., twin-cylinder Ideal-Ajax steam engine drives the drawworks

IN DEEP DRILLING THE TREND DEFINITELY POINTS TO.....

SPANG Seamless EXTREME LINE CASING

NOTE THESE TYPICAL FIELD PERFORMANCE SETTINGS!

AT

WASCO, CALIFORNIA

12020 FT.

Total of 298 joints of Standard Seamless 7" Extreme Line Casing. Running time of string, 7 hours 15 minutes, averaging 1657 feet per hour.

AT

KETTLEMAN HILLS, CAL.

10815 FT.

The world's longest string of 6⅝" Extreme Line Casing. Total weight 281,190 pounds. Run to the bottom of a 2-mile hole without a hitch. All-over average time per joint was 2.67 minutes,—shortest running time being 1.5 minutes.

AT

RODESSA, LOUISIANA

9455 FT.

Standard Seamless 7", 28-pound Extreme Line Casing. Run in 7 hours, 6 minutes, including all delays and time out for lunch, averaging 1331 feet per hour, 33 joints per hour, or 1 minute 49 seconds per 40 ft. joint.

AT

WASCO, CALIFORNIA

11572 FT.

A string of Standard Seamless 7", 30-pound Extreme Line Casing required a total of only 10 hours, 5 minutes, including 1 hour 45 minutes for changing blocks. Actual running time, 8 hours 20 minutes!

SPANG CHALFANT, INC.

GENERAL OFFICES: Grant Building, Pittsburgh, Pa.

SALES OFFICES: Boston New York Philadelphia Pittsburgh Atlanta Chicago
St. Louis Tulsa Houston Denver San Francisco Los Angeles

only very short periods. A Hamer line blind installed in the suction of the No. 1 pump facilitated compounding when necessary. Mud mixing was by an Ideal 14½-in. by 7½-in. by 18-in. pump. Weight material used was Baroid. The mud returns were passed through two Jeffrey "Blue Streak" shale shakers. Valves used for main steam and mud lines were Nordstrom and Crane.

Steam Generating Plant

Because this is the first 500-lb. steam ever used in well-drilling operations great interest has been evinced in the equipment used in the steam generating plant. Steam at this high pressure supplied power to the drawworks engine, the two slush pumps, the boiler feed pumps, the turbo generators, and the bug blower. The other steam-operated equipment used steam at 350 lb. per sq. in. so part of the supply from the boilers was reduced from 500 lb. to 350 lb. by a pressure-reducing regulator.

Five Broderick 130-hp., 500-lb. w.s.p. boilers of the locomotive type, the first of this size ever constructed, were used for generating the steam. This battery was capable of delivering 3000 boiler hp. and has developed no difficulty after service in drilling these two wells to below 11,000 ft.

The special construction features of the boilers are the use of high-tensile steel (70,000 lb. per sq. in.) in the shell and wagon top plates; the use of flexible stay-bolts to allow for expansion of the firebox, and the use of only flanged connections to the boiler. All joints and rivets are calked inside and outside the boilers. The handhole openings on the wagon top of the firebox are reinforced by steel forgings so that flat handhole plates can be used. High-pressure type gaskets are used on the handhole plates and connections to the boiler.

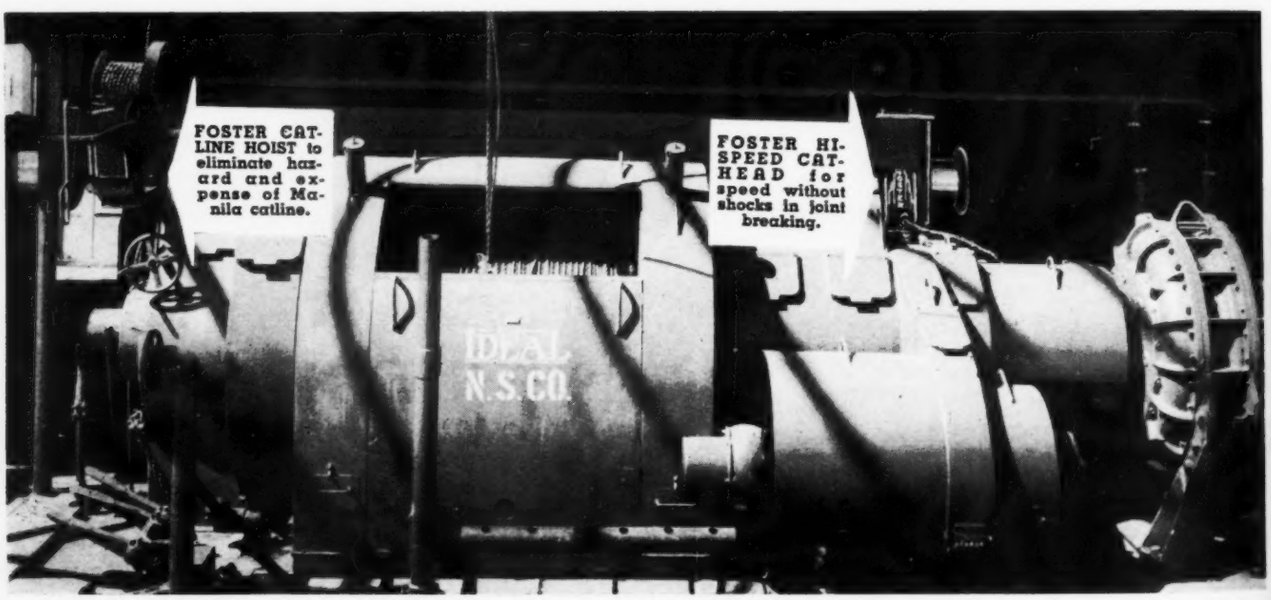
The boilers are equipped with superheaters developing a total steam temperature of 610° F. Two saturated steam and one superheated steam, steel-bodied, fully-exposed, spring-type Crosby safety valves having a relieving capacity of 24,000 lb. steam per hour are used on each boiler. The feedwater used was treated to prevent scale and caustic embrittlement of the steel.

The boilers were insulated to increase efficiency and reduce temperature strain on the plates. The removable insulated jackets supplied by Johns-Manville were designed to provide an insulation covered by a steel casing. These jackets are fabricated of 16-gauge iron reinforced by angles and shaped to the boiler in the shop before installation in the field. The insulation is made up in sections bolted together to provide an allowance for contraction and expansion. They are further secured in place by means of 3-in. circumferential straps placed over the joints.

Asbestos-sponge-felted sheets are used as insulation in the removable jackets. This material consists of laminations of asbestos paper containing small particles of sponge mixed with

FOSTER CATHEAD EQUIPMENT CHOSEN FOR WORLD'S MOST POWERFUL DRILLING RIG

Sold by National Supply Co. to Superior Oil Co. for Deep Test in California


FOSTER CAT-LINE HOIST to eliminate hazard and expense of Manila catline.
FOSTER HI-SPEED CAT-HEAD for speed without shocks in joint breaking.
IDEAL
N.S.CO.

Rig Specifications: Five, 130 h. p. Boilers, 500 lbs. working pressure; 15 x 14 Twin Engine; 15½ x 9¼ x 22 pumps

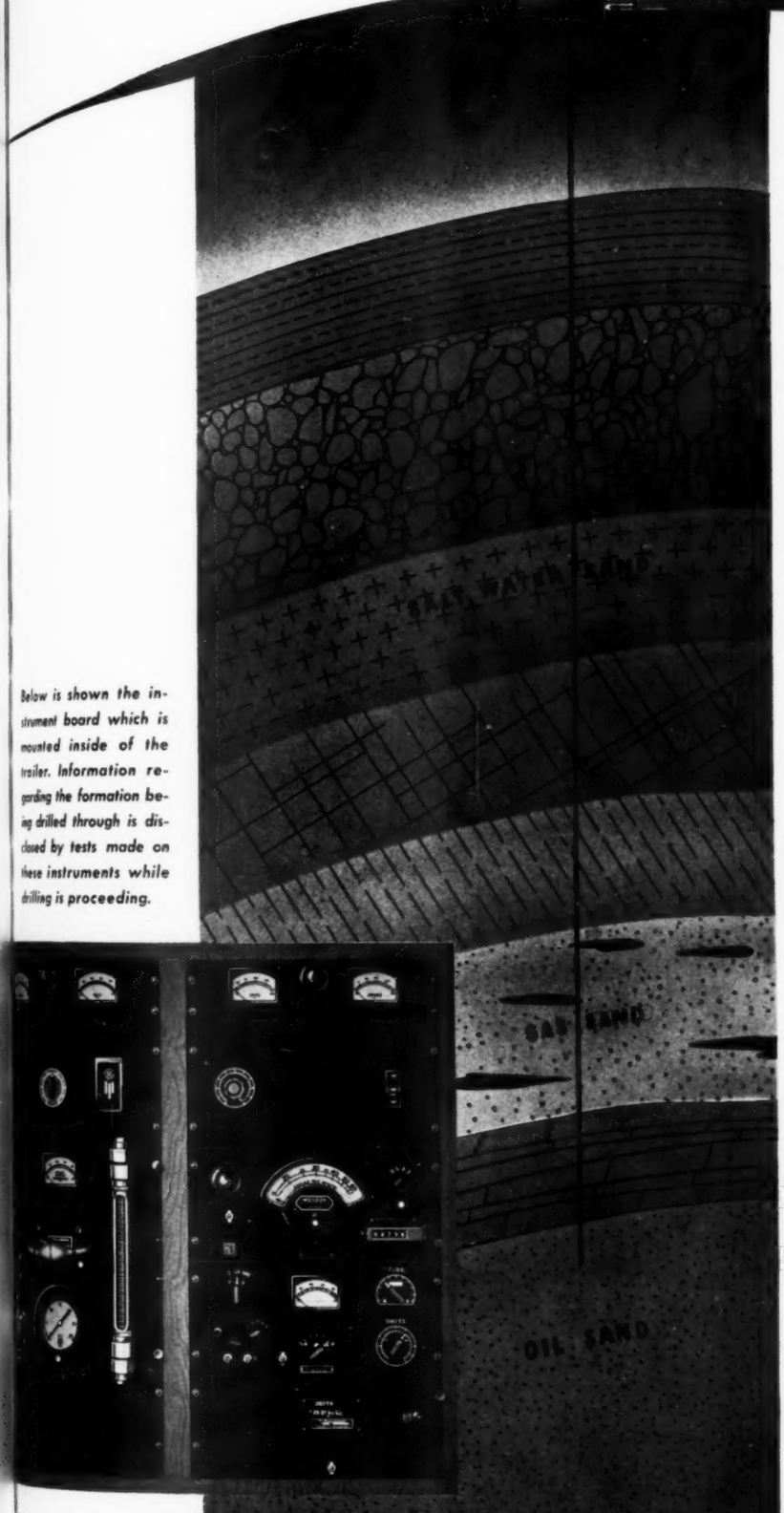
WHERE DEEPER DRILLING IS ANTICIPATED AND MORE POWERFUL RIGS ARE BUILT, FOSTER CATHEAD EQUIPMENT IS PREFERRED

See this Foster Cathead equipment, Petroleum Exhibit, New York World's Fair.

Sold and recommended by Manufacturers and Distributors of Rotary Draw Works everywhere.

FOSTER CATHEAD COMPANY, WICHITA FALLS, TEXAS

ANNOUNCING



Below is shown the instrument board which is mounted inside of the trailer. Information regarding the formation being drilled through is disclosed by tests made on these instruments while drilling is proceeding.

THE BAROID WELL LOGGING SERVICE

The Baroid Well Logging Service takes advantage of the fact that the oil, gas, or salt water content of any formation drilled up by the bit must of necessity be picked up by the drilling mud as it is circulated. By accurate correlation with the depth of the hole it is possible to determine relative quantities of gas, oil, or salt water contained in the formation being drilled.

The Baroid Well Logging Service is probably the only logging system that can detect an oil or gas sand before it is actually reached. Information also disclosed by the Baroid Well Logging Service has made it possible to detect washouts and thereby prevent twistoffs which might have resulted in costly fishing jobs.

Gas-oil ratios have been reduced in some fields due to the knowledge of formations indicated by this method of logging. In many wells drilling costs have been greatly reduced due to the fact that coring has been minimized.

All of the equipment required for this service is mounted in a trailer which can be used at a well and then can be moved conveniently to another well when desired.

These trailers are available to oil companies or operators on a lease basis.

If you have not received your copy of a booklet describing the Baroid Well Logging Service in detail, one will be sent on request from any Baroid Sales Department office.

BAROID SALES DEPARTMENT
NATIONAL PIGMENTS & CHEMICAL DIVISION OF
NATIONAL LEAD COMPANY
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BAROID
WELL LOGGING
SERVICE
FORMATION INFORMATION THROUGH MUD ANALYSIS

the paper while it is in pulp form. The paper is then built-up into blocks having 40 laminations per in. The jackets are filled with these blocks, which are 1½ in. thick and held in place in sections by means of tie wires and by galvanized hardware cloth. The jackets may be removed and put on any number of times without destroying the insulation efficiency. For the temperatures used in the boilers described above, the insulation has an efficiency of 92.6.

Each boiler was equipped with a water column and a Reliance low-water alarm. An Inferno "Clamp Type" Reflex gauge was mounted on the water column instead of on the back of the boiler. These gauges have been recently placed on the market. They are made of stainless steel, are tested to 2500 lb., and are designed for working pressures to 1000 lb. and temperatures to 1000° F. The clamps distribute the pressure over the entire surface of the glass to prevent glass breakage due to uneven tightening. Inferno gauge cocks are also mounted on the water column.

A Pinkerton feedwater level regulator was used on each boiler, situated on one side near the firebox end. The blowdown valves of the boilers were connected to the blowdown headers by an expansion joint to eliminate the danger of breakage. Two sets of blowdown valves were used, one on the front and the other on the back of the firebox.

The boilers were fired by CT Air-Cooled Sonner burners. These burners provide positive control of the primary air, secondary air, and gas. The amount of primary air is automatically regulated by the speed of the gas stream as it leaves the orifice. As the gas pressure increases, the velocity of the gas stream is increased and more primary air is entrained and delivered to the burner head. The application of secondary air through the openings between the gas slots, to both sides of each flame ribbon, assures complete aeration of the fire within a few inches of the gas ports. In addition to this designed control of secondary air, the burner offers supplemental control by means of louver shutters that open and close automatically according to variations of gas pressure. The amount of air is in constant proportion to the amount of gas being burned.

Fuel gas to the battery was regulated with an N.G.N. "Boiltrol" controlled by pressure through a line from the main steam header. Air into the burners was regulated by a Wilgus regulator at each boiler. The entire operation of the boilers was automatic during the drilling of both wells. The fuel gas was measured by a Metric orifice meter and the orifice plate was enclosed in a Daniel orifice fitting. Fuel consumption during drilling was from 750,000 to 850,000 cu. ft. of gas per day.

The two boiler-feed pumps used with the super rig installation are also the largest of their kind. These are Ideal 10-in. by 6¼-in. by 10-in. and operate on 500-lb. steam. The recommended maximum water pressure is 1500 lb. per sq. in. and the normal speed is 60 s.p.m. Displacement per pump with 6¼-in. liner at 60 s.p.m. is 305 gal. per minute. The suction connection is 6 in., the discharge, 3 in., steam inlet, 2 in., and steam exhaust, 3 in.

Mounted as a unit with the boiler-feed pumps were two turbo generators especially designed by Turbolite, Inc., to operate with this installation on 500-lb. steam. These generators have a capacity of 10 kw. each. All manifolding for the boilers and mud lines were pre-fabricated by Crane Company.

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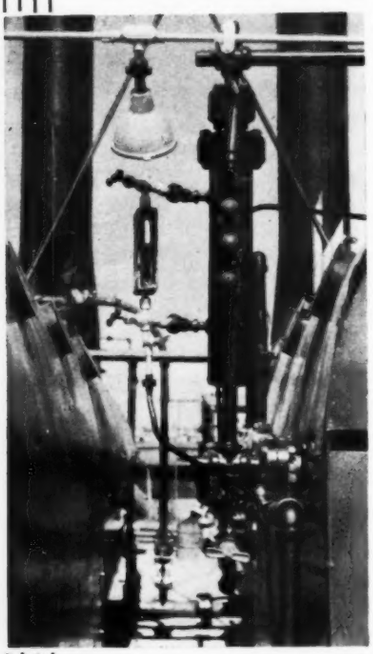

Yes, INFERNO Stainless Steel Gauge Cocks, guaranteed never to break or twist off in the boiler, and the new INFERNO "Clamp Type" Stainless Steel Reflex Gauges are in use on those big boilers, rated at 500 lbs. working pressure, on the Superior Oil Company's Moody No. 1, Rio Bravo Field, California. The photograph is a close-up of three INFERNO Gauge Cocks and one INFERNO "Clamp Type" Reflex Gauge on the Lowater Alarm between two of the five boilers.

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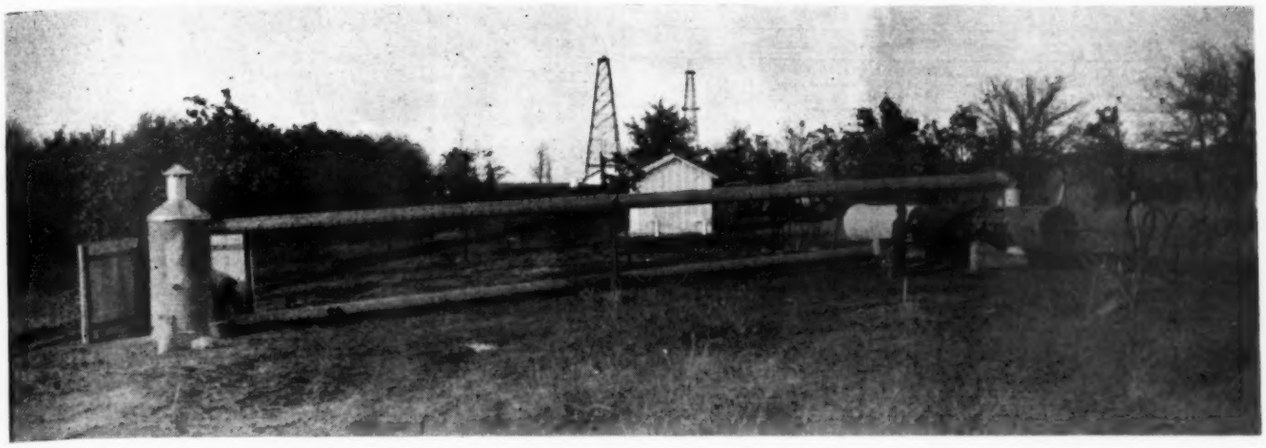


General view of the installation showing boiler, heater, and regulator station. Insulation is being applied to the heater

Hot-Water Heater for Preventing Freeze-Offs of Large-Volume Gas Well

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Installation in Cement Field, Oklahoma, eliminates fire hazard that accompanies open-flame burning

By
ROY W. PARKER
Oklahoma Natural Gas Company

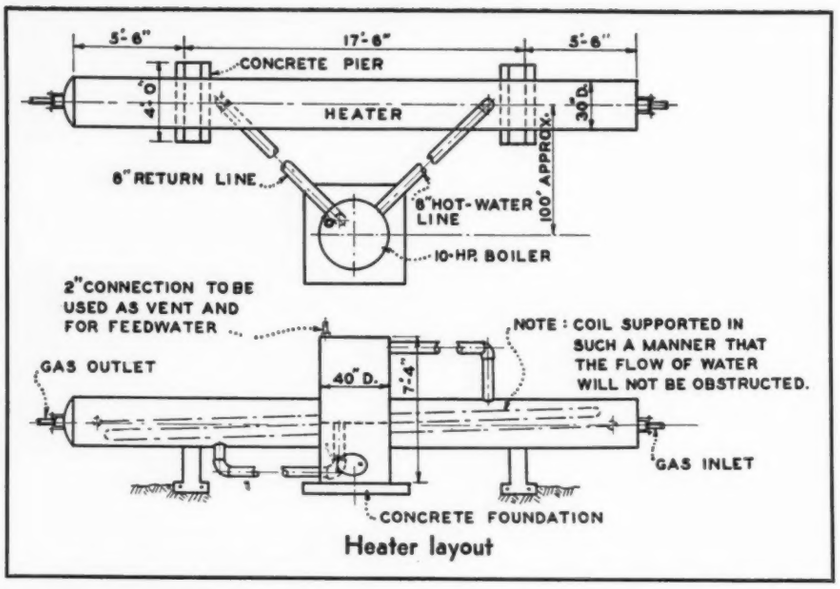
FREEZE-OFFS that occur in high-pressure lines from gas wells, particularly when the supply is most needed, have always constituted an operating problem. This problem is of even more significance in a well having an open-flow almost equal to the total peak demand of an entire transmission and distributing system. Such a well is owned by the Oklahoma Natural Gas Company in the Cement Field, Caddo County, Oklahoma. Well No. 1960 has an open-flow of 161,700,000 cu. ft. per day, at a rock pressure of 2035 lb. per sq. in. No operator would question the advisability of attempting to keep a well of this capacity on-the-line at all times. The behavior of this well when conventional discharge flow lines were employed was no different than other high-pressure wells, resulting in freeze-offs and the accompanying reduction of pressure to the main line. The original piping system from well to main line consisted of four parallel lines ranging in size from ¾ in. to 2 in. These lines were well covered and as the expansion was over a long range they functioned satisfactorily for a time. Seasonal temperature changes and additional demands on the well, however, made it apparent that some method of preheating the gas would be necessary for continuous delivery.

Several methods of preheating gas to avoid freezing have been used for years. The most popular is the direct-fired heater. This method has proved its worth but there are some objectional features, principally the fire hazard that exists in open-flame burning that often causes pipe to burn and rupture. In an attempt to eliminate such hazards and construct a heater better adapted for the purpose, a hot-water heater was designed for this well.

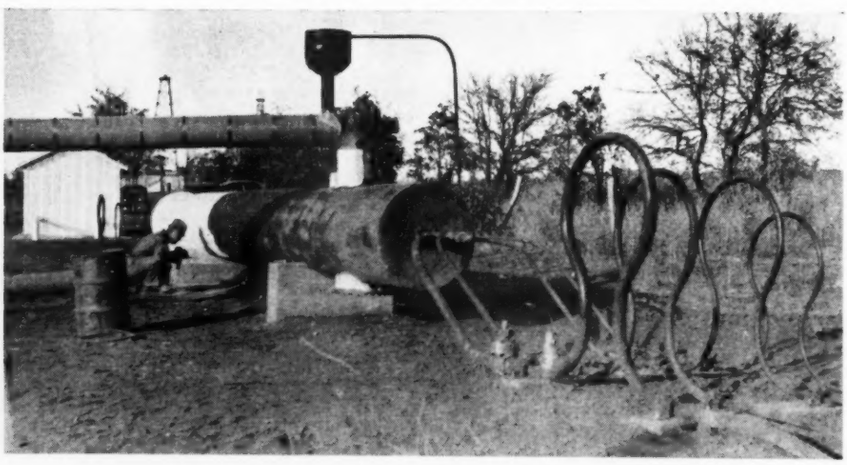
The heating medium is an insulated boiler shell 28 ft. in length and 3 ft. in diameter set on two concrete piers, about 400 ft. from the well. In the

ROY W. PARKER

has been in the employ of the Oklahoma Natural Gas Company for 13 years, one year having been spent in the measurement department, one year in the meter repair department, four years as assistant chemist, four years as chief chemist, and the last three years as industrial sales engineer—Prior to his affiliation with Oklahoma Natural he had been employed in the refining department of The Texas Company, from 1923 to 1926—He is a graduate of Southeastern State College.



Heater layout



Expansion bends at inlet of the header. At top of hot-water line can be seen the overflow funnel and air vent

water-filled shell the coil arrangement comprises five runs of 3-pass 1¼-in. coils tested for 2500-lb. working pressure. The original four parallel gas lines were retained but expansion bends were made to tie-in a streamlined header before the gas enters the heating vessel. The gas leaves the heater through a similar arrangement at the discharge end before coming to the expansion joints. This detail eliminates the sudden directional change of flow of the gas caused by an ell and consequently the pressure drop is reduced. The heat is supplied by a 10-hp. vertical fire-tube boiler. The boiler is situated 100 ft. from the hot-water vessel and connected by 8-in. lines for supply and return. It is fired by a series of burners of the venturi type that extend into the circular combustion space at several ports around the circumference of the boiler. These produce a turbulent fire that covers the entire area of the circular combustion chamber and heat retention is excellent. Control equipment installed on the boiler provides automatic regulation of water temperatures and pressures.

The heater was designed to burn 25,000 cu. ft. of gas per day to obtain a temperature rise of 50 deg. The pipe and fittings in the gas coils are designed for a working pressure of 2000 lb.; the other lines and equipment are standard.

The cost of the installation was about $1200, which includes labor, engineering, and materials.

The heater was in operation during the last winter season and efficient and satisfactory results were obtained.

Other companies had similar type heaters in operation during the winter and excellent results were reported by them also. The trend in gas warming seems to be toward some application of hot-water heating rather than by direct flame.

Road Oil Sales Declined 9 Percent in 1938

DECREASED construction of oil-treated macadam, gravel, and sand-clay highways was reflected in a decline of 9 percent in refinery sales of road oil—from 8,713,650 bbl. in 1937 to 7,904,890 bbl. in 1938. As a result of lower prices, the value at the refineries of road oil sold decreased 20 percent—from $12,183,213 in 1937 to $9,704,689 in 1938.

The declines were greatest in California, Arkansas, and Louisiana Inland, in the Indiana, Illinois, Kentucky, etc., district, in the Rocky Mountain district, and in the East Coast district. Gains in the Oklahoma, Kansas, and Missouri district, in the Appalachian district, and in the Louisiana Gulf Coast district were insufficient to offset the general decline.

Of the road oil sold in 1938, only 632,423 bbl. valued at $1,080,699 were made from foreign petroleum, imported chiefly from Venezuela and Mexico. Of the road oil made from foreign crude, 77 percent was sold by refineries of the Atlantic Coast district in 1937 and 76 percent in 1938; the remainder was sold by Gulf Coast refineries of Louisiana and Texas.

Petroleum refineries in the United States reported the production of 7,542,755 bbl. of road oil in 1938 compared with 8,087,231 bbl. in 1937. The refinery output of road oil in 1938 was augmented by 722,100 bbl. of other petroleum products, chiefly fuel oil, transferred to road oil stocks compared with 1,089,167 bbl. similarly transferred in 1937. Stocks of road oil and of transferred oils held at refineries decreased 44,296 bbl. during 1938, compared with an increase of 127,804 bbl. during 1937. Consumption of road oil at refineries in their own operations, transfers, losses, and adjustments were 404,261 bbl. in 1938 compared with 314,944 bbl. in 1937.

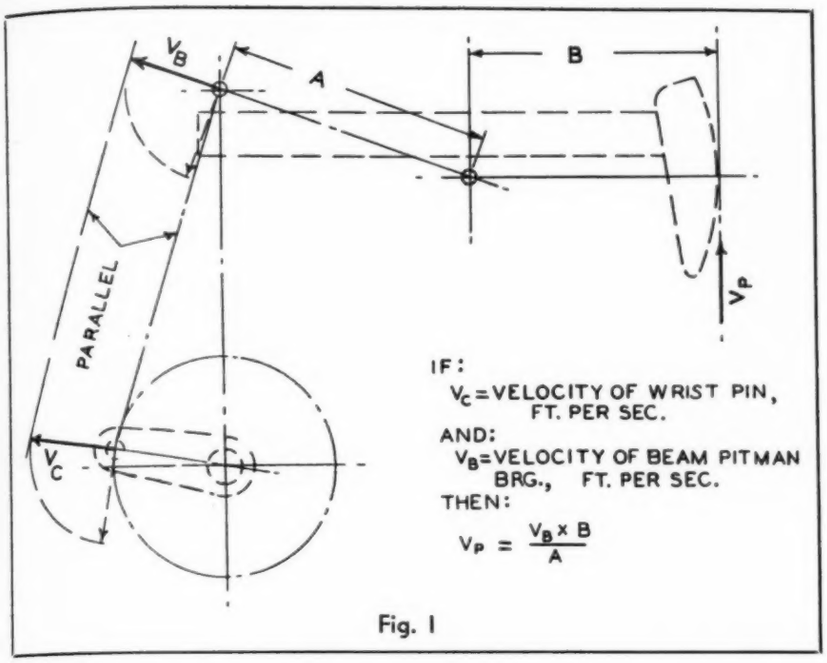


Fig. 1

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Effect of Design and Direction of Rotation on Peak Torque of Pumping Unit

Torque capacity of a specific unit will vary with direction of rotation, therefore both values should be known

By KENNETH N. MILLS, Chief Engineer
and
E. A. OLSOVSKY, Assistant Chief Engineer
American Manufacturing Company of Texas

THE effect of pumping-unit geometry and direction of crank rotation on the average and peak power requirements of a given well has been given considerable study by several investigators, and through their study much valuable information has been obtained, which can be proved analytically. As actual pumping wells were studied, the range of possible variations in pumping-unit geometry was slight, and the exact cause of the observed results could not be determined. An analytical study of the problem reveals that the geometry and direction of crank rotation of a pumping unit control the magnitude of the peak load imposed on the driving mechanism and influence to a very small degree the magnitude of the peak well load.

The important points to consider when analyzing the geometric layouts of the various pumping units are the relative values of the peak acceleration imparted to the polished rod, the relative values of the average and peak power requirements placed on the driving machine, the relative magnitudes

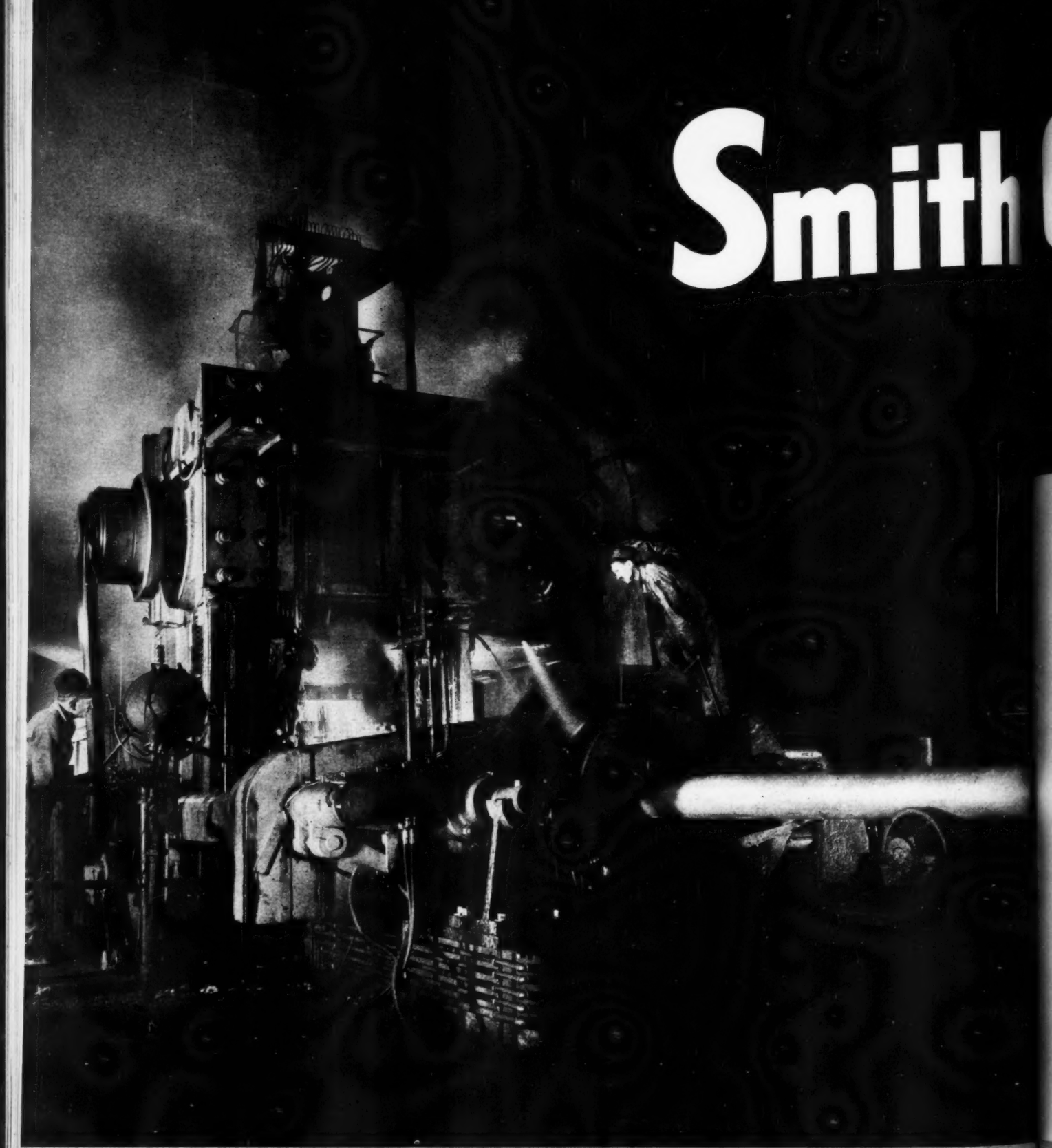
(*Continued on Page 116*)

KENNETH N. MILLS

received a B.S. degree in mechanical engineering from Rice Institute, Houston, Texas, in 1933—He joined the engineering staff of the American Manufacturing Company of Texas, Fort Worth, in 1934 and was placed in charge of that department in 1935—During his association with the petroleum industry he has devoted considerable time to the analytical study of problems encountered in oil-well pumping.

E. A. OLSOVSKY

received a bachelor of science degree in mechanical engineering from the A. & M. College of Texas in 1934—From 1934 to 1936 he sold industrial supplies—Since March, 1936, he has been an engineer on the engineering staff of the American Manufacturing Company of Texas—At present he is assistant chief engineer.



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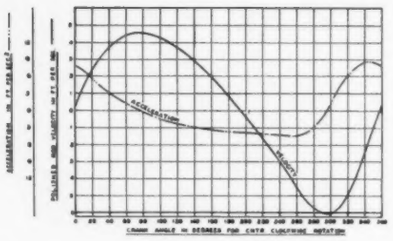


Fig. 2

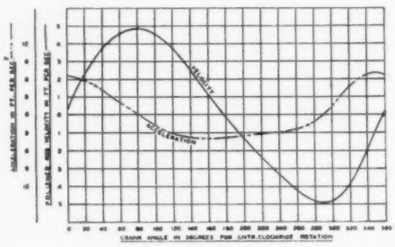


Fig. 3

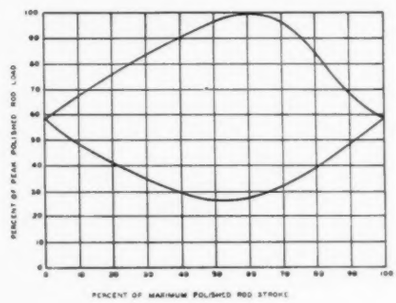


Fig. 4

(*Continued from Page 113*)

of the loads imposed on the various members of the machine, and the possibility of obtaining proper counterbalance with a given type of counterbalance. The numerical value of each of these factors can be found for any type of pumping unit by one of several methods, provided a few simplifying assumptions are made. These assumptions will not affect the comparative value of the results, because the same assumption can be made in each investigation.

In this investigation the polished-rod acceleration curve was obtained by mechanically differentiating the polished-rod velocity curve. The polished-rod velocity curve was obtained kinematically by the link-to-link method. The mechanics of this method of determining the velocity of the beam pitman bearing with reference to the linear velocity of the crank is illustrated in Fig. 1, and using the terms shown in that figure, the equation for the velocity of the polished rod is:

$$V_p = \frac{V_b \times B}{A}$$

where:

V_p = polished-rod velocity, ft. per sec.

V_b = velocity of beam pitman bearing, ft. per sec.

A and B = dimensions illustrated in Fig. 1.

In applying this method of calculating the polished-rod velocity it was assumed that the crank rotated at a constant speed. This assumption is not true, but for comparative purposes it is satisfactory, as the same assumption was made in each case.

The polished-rod velocity-and-acceleration curves shown in Figs. 2 and 3 were obtained by using geometric layouts 2 and 6, respectively. These basic designs are shown in Figs. 10 and 14 and are representative of all the geometric layouts investigated. Inspection of these curves reveals that the motion imparted to the well by the pumping unit is not simple harmonic, and that the maximum acceleration occurs near the beginning of the lift part of the pumping cycle, regardless of the direction of crank rotation.

The values of the peak and average amounts of power required to drive the pumping unit will depend on the nature of the connected load and the efficiency of the machine. The nature of the connected load used in this investigation is shown in Fig. 4, and it was determined by averaging the dynamometer cards of about 35 wells

Fig. 5

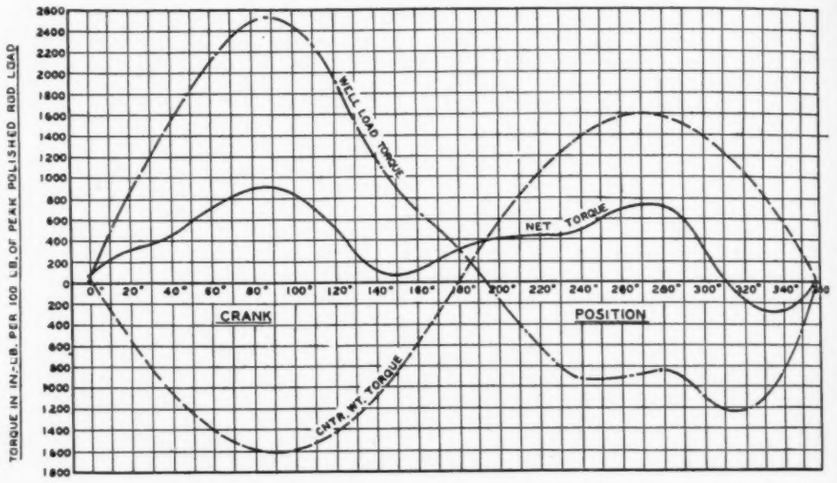
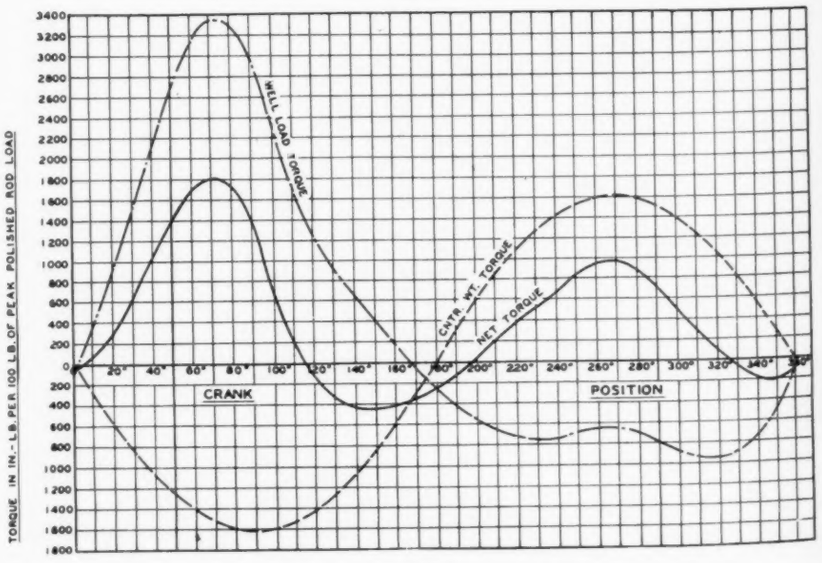


Fig. 6



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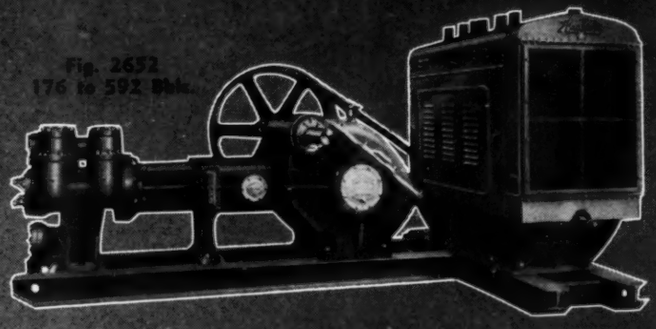

Fig. 2652
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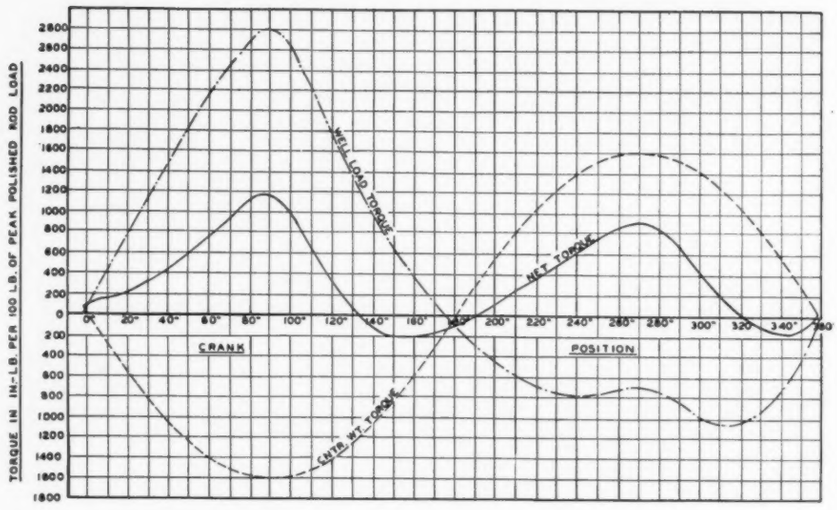

Fig. 7

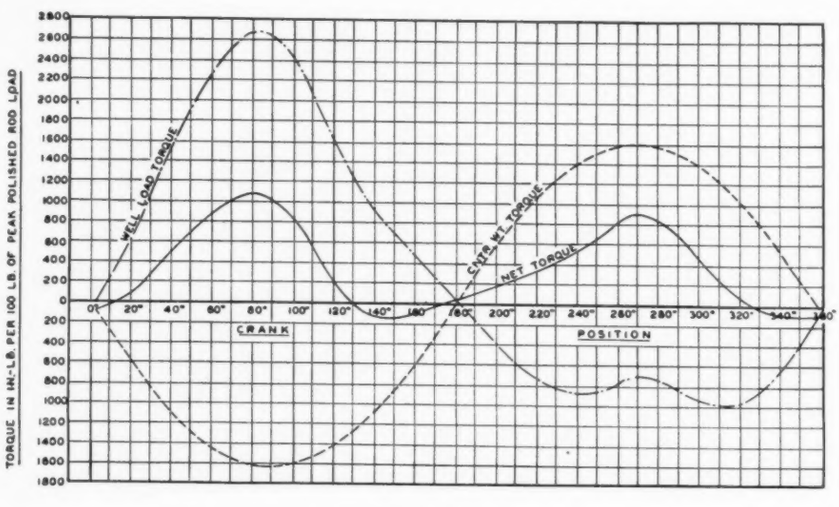

Fig. 8

selected from a group of about 70 wells. The wells considered ranged from 2000 to 4200 ft. in depth and were being pumped at speeds of 16 to 25 s.p.m.

The slow-speed shaft torque curves shown in Figs. 5 and 6 are based on geometric layout 2 and Figs. 7 and 8 are based on geometric layout 6, when connected to a load whose characteristics are defined by the dynamometer card shown in Fig. 4, and balanced with a rotary counterbalance, rotating at a constant speed, whose maximum effective balance is equal to 60 percent of the peak well load. The assumption that the counterbalance is rotating at constant speed introduces a condition that never exists in actual practice and possibly introduces a small error. For comparative purposes this error is unimportant, as the same variation is made in each case, and the amount of speed variation in the pumping cycle is largely dependent on the amount of rotating inertia in the system. The values of the slow-speed shaft torque used were obtained by taking moments around the beam saddle bearing and multiplying the pitman load thus determined by the effective crank arm at the instant under consideration. Inspection of these curves reveals that the magnitude of the peak torque imposed on the speed reducer is not the same for all types of pumping unit layouts, and that the amount of counterbalance required depends upon the geometry of the pumping unit and the direction in which its crank is rotated.

The results of an analysis of peak and average torques, average horsepower, and lengths of stroke created by eight different unit layouts, driving mechanism rotating in each direction, are shown in Table I. The geome-

TABLE I

Rig layout no.	Polished-rod stroke, in.	Percent increase or decrease in stroke	Direction of rotation	Peak unbalanced torque corrected to 54-in. stroke	Percent increase in peak torque over minimum unbalanced torque	Corrected peak balanced torque	Percent increase in corrected peak balanced torque over minimum peak balanced torque	Actual peak torque divided by A.P.I. peak torque	Mean torque corrected to 54-in. stroke	Average power to polished rod, hp. at 20 s.p.m.	Percent increase in average power to rods at 20 s.p.m. over minimum
1	53½	0.93	CCW CW	2460 2990	2.07 24.1	884 1187	11.3 49.6	0.817 1.10	404 377	0.128 0.119	10.3 2.58
2	56½	4.63	CCW CW	2410 3200	0 32.8	794 1319	0 66.2	0.734 1.22	380 408	0.121 0.130	4.30 12.1
3	54	0	CCW CW	2720 2720	12.9 12.9				369 382	0.117 0.121	0.862 4.30
4	56	3.7	CCW CW	2540 2980	5.4 23.6	887 1162	11.7 46.4	0.821 1.08	368 364	0.117 0.116	0.862 0
5	53⅝	0.70	CCW CW	2570 2950	6.64 22.4	908 1153	14.4 45.3	0.841 1.07	385 382	0.122 0.121	5.17 4.30
6	54	0	CCW CW	2800 2685	16.2 11.4	1060 1005	33.5 26.6	0.982 0.931	376 382	0.119 0.121	2.58 4.30
7	54⅛	0.23	CCW CW	2650 2820	9.95 17.0	970 1095	22.2 38.0	0.898 1.01	374 378	0.119 0.120	2.58 3.45
8	55⅝	3.01	CCW	2570	6.64				392	0.124	6.90

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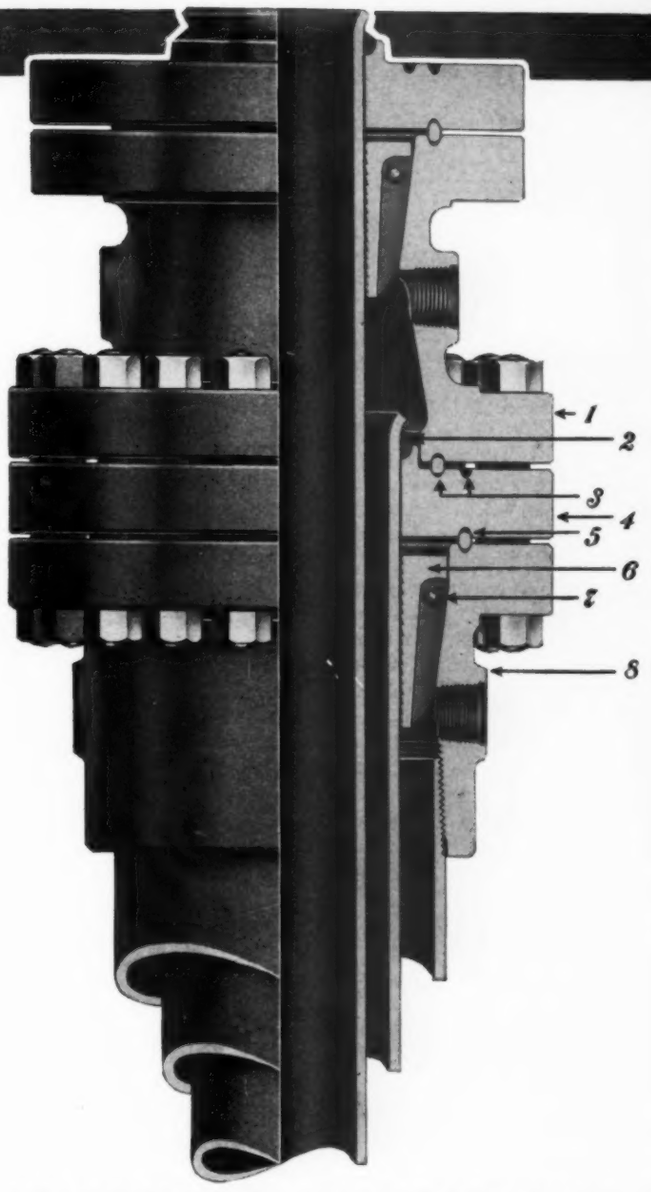
Slip suspension permits landing casing at any point in the well, and suspending with exactly the desired amount of tension in the string. Slip design eliminates letting off weight of casing on cement, backing out top joint and cutting nipple, etc. The slips are assembled around the casing by means of aligning bolts, which insure equal distribution of weight when the casing is landed.

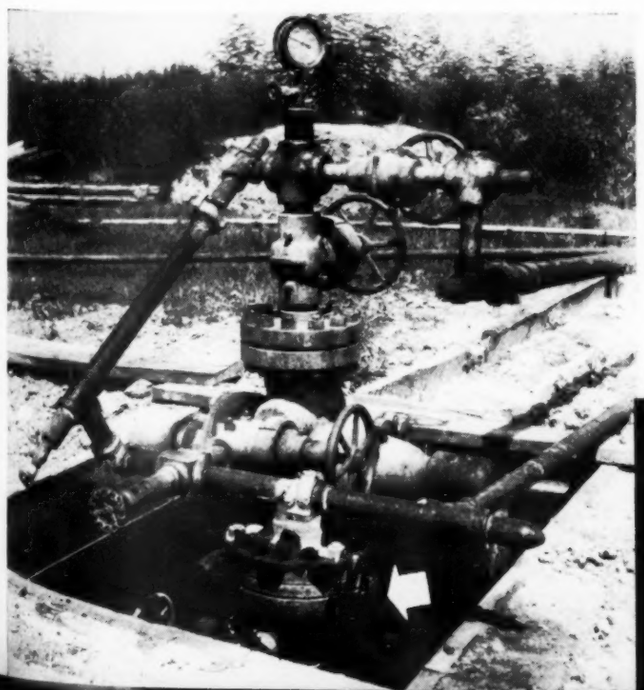
After casing has been suspended, it is cut off above the slips as shown in the cross-section drawing at right, and the Type "J" Welding Flange is then stripped over and bolted down to the casing head or spool with six studs. Construction weld is then applied as shown by Fig. 2 herewith. If desired, a Type "M" Welding Flange can be furnished at a slight additional cost, which provides a unique means for visually testing the efficiency of each construction weld with hydraulic pressure to insure pressure-tightness before installing casing spool or Christmas Tree.

Complete details concerning the Cameron Type "J" Casing Heads and Spools will gladly be furnished to interested operators on request.



(1) Casing Head Spool; (2) Construction weld; (3) Standard A.P.I. ring groove (outer), restricted ring groove (inner); (4) Type "J" Welding Flange; (5) Standard A.P.I. ring groove; (6) Split and bolted slips; (7) Aligning bolts; (8) Casing Head housing.

BELOW: Cameron Type "J" 4000-lb. Test Casing Head and Cameron Safety Christmas Tree through which the operator tested five sands before completing the well as an eastern extension to the Fairbanks, Harris County, Texas, field.



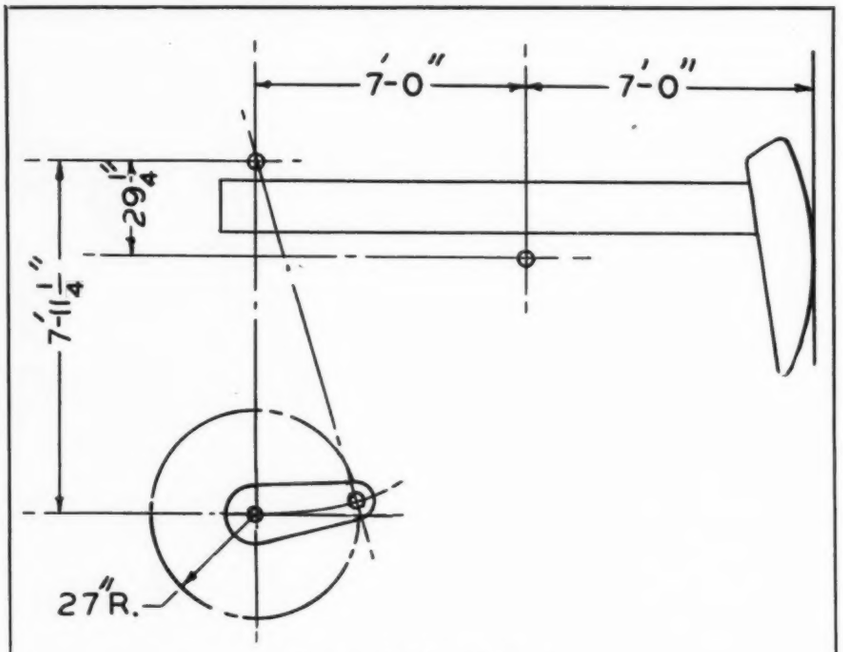


Fig. 9. Rig layout No. 1

try of the units analyzed is defined in Figs. 9, 10, 11, 12, 13, 14, 15, and 16. In each case, the figures shown have been corrected to a 54-in. stroke, and those figures involving counterbalance have been corrected for counterbalance, i.e., so their net peak torques were equal. The term counter-clockwise rotation, as used in Table I, means that when the crank is in its uppermost position it is traveling away from the well. The analyses of layouts 3 and 8 (Figs. 11 and 16) were not completed because the layouts were not applicable to rotary counterbalance. Examination of the data shown in this table reveals that all the items investigated vary with the geometry of the unit and the direction of crank rotation.

The column "actual peak torque divided by A.P.I. peak torque" was obtained by dividing the actual peak torque imposed on the driving mechanism by the peak torque found by multiplying the length of the crank arm by 40 percent of the peak well load. A comparison of the figures shown in this column reveals that not every peak torque found by the latter method is correct, and that each type unit should have a torque conversion factor rating to enable the user to apply his unit correctly. The numerical value of this factor would be the distance from the center line of the saddle bearing to the polished-rod divided by the normal distance from the center line of the saddle to the pitman when the crank arm is at its maximum effective radius.

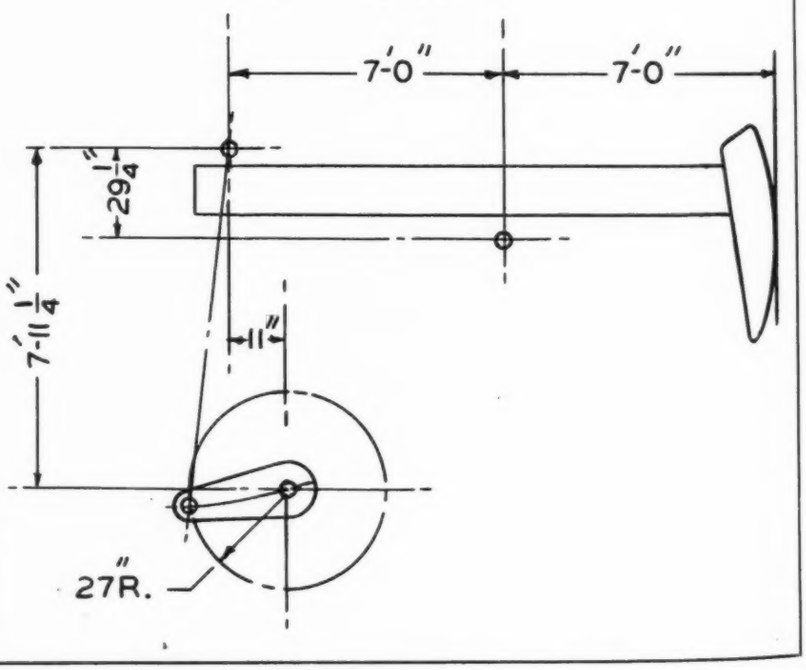
The maximum effect of changing the direction of crank rotation is realized when the beam pitman bearing is situated at some point above the horizontal center line of the saddle bearing, and in this type of unit layout the minimum peak torque is obtained when the crank is rotating counter-clockwise. The reason for this phenomenon is that, in units of this type, the horizontal component of the pitman pull supplies an additional rotating moment to the beam, which reduces the required pitman pull to a value smaller than that which would be required if this moment did not exist. This condition is illustrated in Fig. 17, and, using the dimensions and terms designated in that figure, it can be seen that for equilibrium, the following equation must be satisfied, and therefore the above statement is correct.

$$WB = NA + BR$$

It is possible, by adjusting the beam pitman bearing with reference to the horizontal center line of the beam saddle bearing, to produce a geometric layout that will impose equal peak loads on the driving mechanism regardless of the direction of rotation. The exact location of beam pitman bearing to produce this condition depends upon the location of the crankshaft with reference to the beam pitman bearing. Regardless of the location of the crankshaft, a unit layout that has this characteristic will impose higher peak loads on the driving mechanism than an equivalent unit in which the beam pitman bearing is placed farther above the horizontal center line of the saddle shaft and the crank rotates in the proper direction. Therefore, a unit having this characteristic is impractical, as its efficiency when measured by this criterion is low.

The location of the crankshaft with reference to the beam pitman bearing influences the magnitude of the peak torque imposed on the driving mechanism by the well. For any group of

Fig. 10. Rig layout No. 2



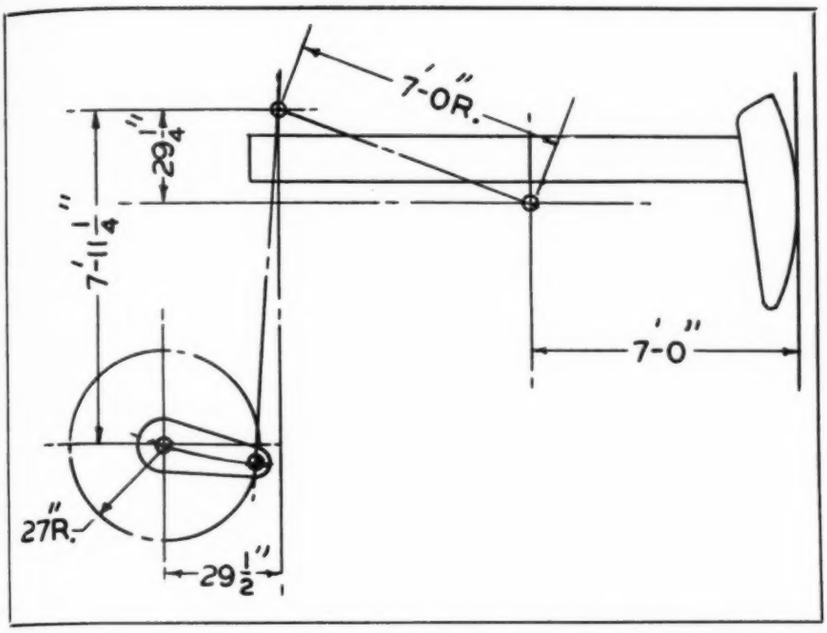


Fig 11. Rig layout No. 3

bearing and the direction of crank rotation. Conversely, if the latter variables are fixed, it is dependent on the ratios of the pitman length to crank radius and pitman-end working center distance to crank radius. The relative lengths of the pitman and pitman-end working center enter into the determination of the most effective crankshaft location, because these two factors influence pitman angularity and the proportional change in the normal distance from the center line of the pitman to the center of the beam saddle bearing. As both these factors control

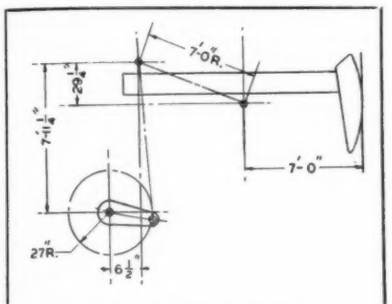


Fig. 12. Rig layout No. 4

units whose ratios of pitman length to crank radius and pitman-end working center distance to crank radius are equal, the exact location of the crankshaft relative to the beam pitman bearing for lowest net peak torque depends upon the location of the beam pitman bearing with reference to the horizontal center line of the saddle

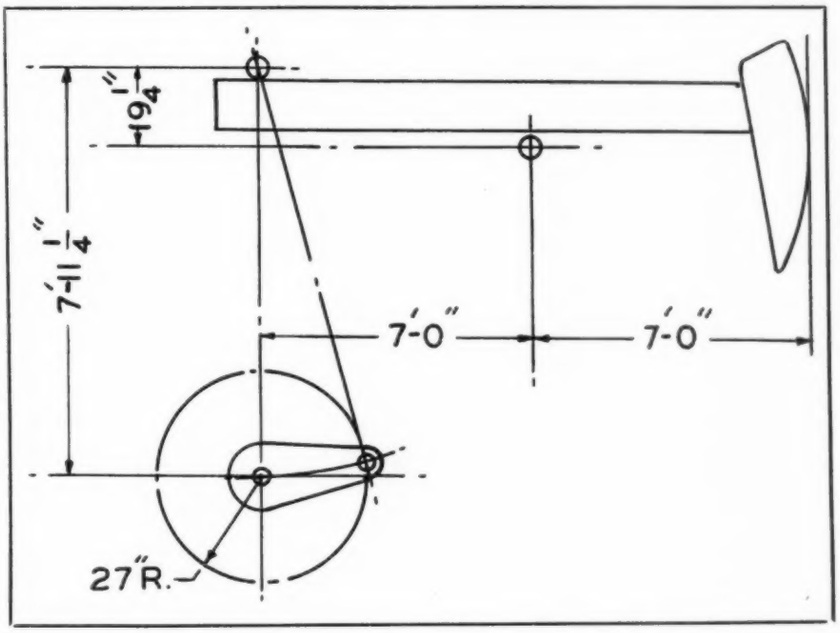


Fig. 13. Rig layout No. 5

TABLE 2

Rig layout no.	Peak lift polished-rod velocity, ft./sec. corrected to 54-in. stroke	Peak down polished-rod velocity, ft./sec. corrected to 54-in. stroke	Percent increase in lift polished-rod velocity over minimum	Percent increase in down polished-rod velocity over minimum	Peak polished-rod acceleration, ft./sec.², corrected to 54-in. stroke	Percent increase in polished-rod acceleration over minimum	Acceleration factor at 20 s.p.m. ($g = 32.2$ ft./sec.²)	Direction of rotation	Percent increase in acceleration factor over minimum
1	4.48 5.63	5.63 4.48	2.05 28.2	28.2 2.05	7.50	8.70	1.233	CCW CW	1.56
2	4.39 5.83	5.83 4.39	0 32.8	32.8 0	8.10	17.4	1.252	CCW CW	3.13
3	4.89 5.00	5.00 4.89	11.4 13.9	13.9 11.4	6.90	0	1.214	CCW CW	0
4	4.54 5.49	5.49 4.54	3.42 25.0	25.0 3.42	7.80	13.1	1.242	CCW CW	2.30
5	4.63 5.42	5.42 4.63	5.47 23.5	23.5 5.47	7.57	9.72	1.235	CCW CW	1.73
6	4.86 4.93	4.93 4.86	10.7 12.3	12.3 10.7	7.05	2.18	1.219	CCW CW	0.412
7	4.70 5.19	5.19 4.70	7.07 18.2	18.2 7.07	7.20	4.35	1.224	CCW CW	0.823
8	4.57	5.49	4.10	25.0	7.26	5.22	1.226	CCW	0.988

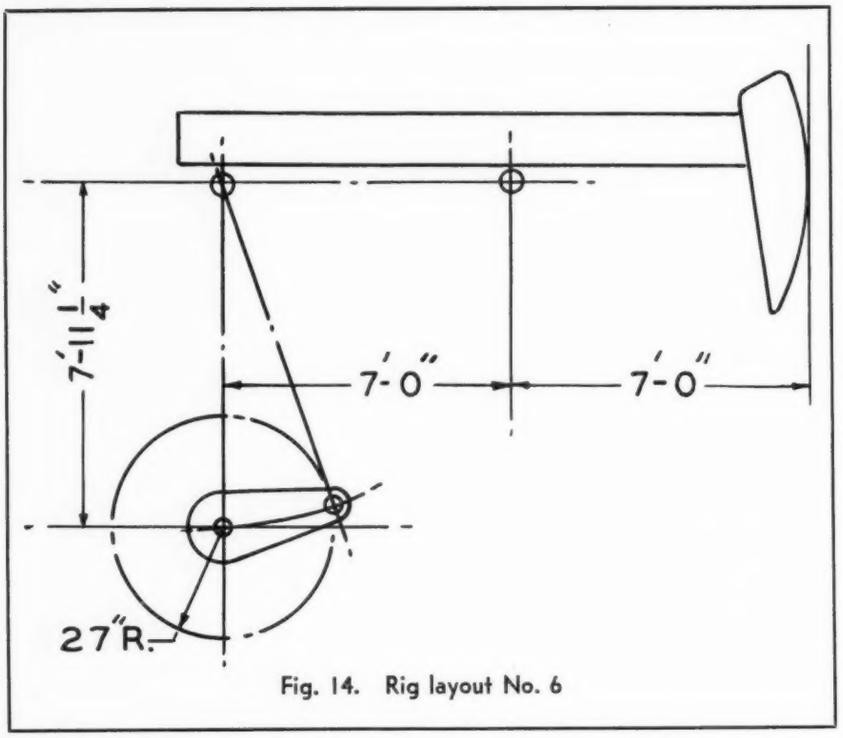


Fig. 14. Rig layout No. 6

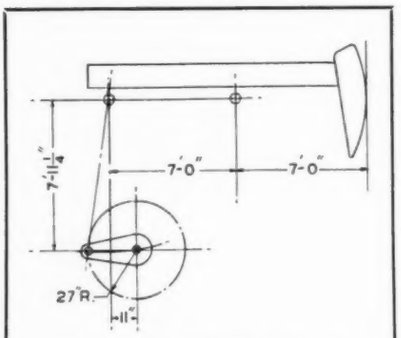


Fig. 15. Rig layout No. 7

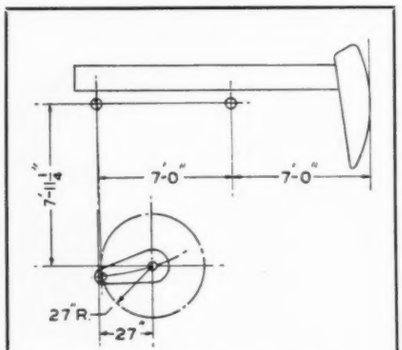


Fig. 16. Rig layout No. 8

the magnitude of the pitman load, they influence the magnitude of the net peak torque.

The results of an analysis of polished-rod velocities and accelerations created by the eight unit layouts, their driving mechanism rotating at a constant speed, is shown in Table 2. The figures given in this table have been corrected to a 54-in. stroke. Examination of the data shown in this table reveals that there is a wide variation in both the maximum polished-rod velocity and the acceleration imparted to the well by units of different geometric layouts.

The variations in polished-rod acceleration between the various layouts investigated is unimportant, because, when it is reduced to an acceleration factor, the variation in the acceleration factor is not large. Furthermore, owing to the differences in the rates of stress transmission in the mediums responsible for most of the peak well load, the entire static well load is not affected by the acceleration. If all the properties of the fluid and sucker rods except their rates of stress transmission were identical, only a small portion of the fluid mass would be accelerated during the period of peak acceleration, because of this difference, and the great degree of compressibility of the fluid further tends to reduce the importance of fluid acceleration. These two factors further tend to reduce the importance of differences in the rates of acceleration at the polished-rod produced by the various geometric layouts investigated.

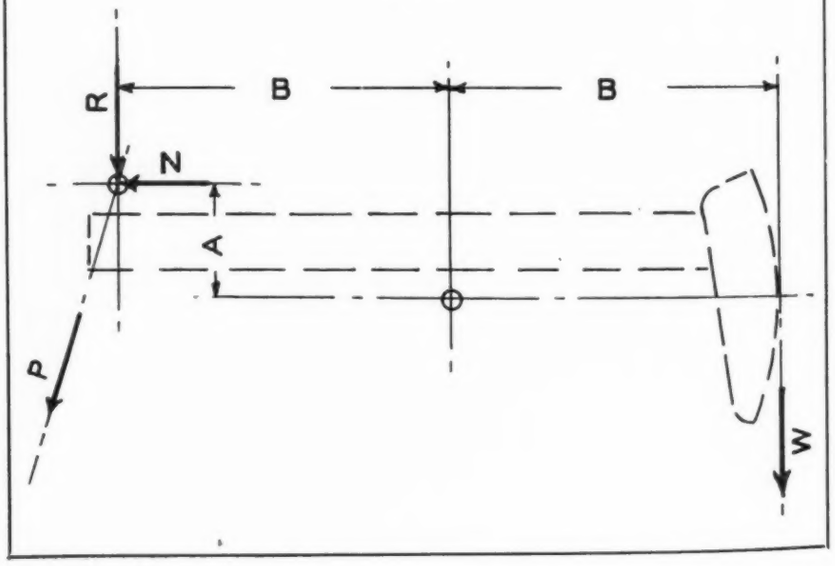
An investigation of the load imposed on the various members and bearings used in the unit reveals that these loads also vary with the layout used, but as the size of these elements is controlled by the designer of the machine, they are relatively unimportant and will not be included in this study.

The results of this investigation indicate that the geometry of a pumping unit, together with its direction of rotation, control the magnitude of the peak torque imposed on the reducer, and therefore each unit should carry a torque factor on its name plate, which would enable the user to determine the true torque capacity of the unit assembly when the crank rotates in either direction.

Acknowledgment

Grateful acknowledgment is made to S. E. Corry, of the American Manufacturing Company, for his assistance in preparing some of the mechanical data presented in this paper.

Fig. 17



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Some of the Clinic Subjects

FIELD WORK	PUBLICITY
PERFORMANCE DATA	MARKET DATA
DIRECT MAIL	MEASURING RESULTS
INDUSTRIAL EXHIBITS	CATALOGS
READERSHIP VALUES	SALES MANUALS

TIE-UP WITH SALES FORCE

EXHIBITS
•
AWARDS
•
LADIES' PROGRAM
•
DINNER AND SHOW AS USUAL

National Industrial Advertisers Association
100 East Ohio Street **Chicago, Illinois**

2-39

LAUGH WITH BARNEY

Friend: When your husband craves a kiss, do you always give it to him?

Jealous Wife: I wish I knew.

* * *

Stenographer: Howja spell "sense?"

Employer: Dollars and cents or horse sense?

Stenographer: Well, like in "I ain't seen him sense."

* * *

Here's one about the writer who was rejected by his girl. So he threw himself in the wastepaper basket.

* * *

A little colored boy going through a cemetery read this inscription on a tombstone: "Not dead, but sleeping."

Scratching his head, and pondering, he finally said, "He sure ain't foolin' nobody but hisself."

* * *

The postman on a country route called Jim out and handed him a black-edged envelope.

"Look's like somebody died," he said.

"Y-yes," answered Jim in a worried tone. "It's my brother Joe. I recognize his handwriting."

* * *

"Captain, is this a good ship?"

"Why, madam—this is her maiden voyage!"

* * *

Roustabout: Ginger ale.

Waiter: Pale?

Roustabout: No—just a glass.

* * *

"Mirandy," said the colored preacher, as he led her toward the brook for baptism, "I'se gwine to lead you out here in dis stream an' wash all youah sins away."

"Lawsy, Pashon," giggled the erstwhile frolicsome damsel, "in dat li'l ole shallow creek?"

* * *

A young Scottish recruit was put on sentry-go outside the general's tent. In the morning the general rose, looked out of his tent, and said in a stern and loud voice: "Who are you?"

The young man turned 'round smartly and replied, "Fine Sir! Hoo's yersel'!"

Asked to write a brief essay on the life of Benjamin Franklin, a little girl wrote this gem of a paragraph:

"He was born in Boston, traveled to Philiadelphia, met a lady on the street, she laughed at him, he married her, and discovered electricity."

* * *

"Joseph . . . JOSEPH!"

"What, ma?"

"Are you spitting in the fish bowl again?"

"No, but I been coming awful close."

* * *

An Englishman heard an owl for the first time.

"What was that?" he asked.

"An owl," was the reply.

"My deah fellah, I know that, but what was 'owling?"

* * *

This month's absent-minded contest was won by the druggist who was asked if he had a wife and replied, "No, but I have something just as good."

* * *

It must be rather nice, though, to be wealthy enough to speak in glowing terms of the blessings of poverty.

* * *

"Pat." said the manager of the factory, "I want you to report to me at six o'clock tomorrow morning. Here's an alarm clock."

The next morning arrived. Pat was met by a frowning manager.

"Well, what was the matter? Didn't the alarm clock go off?"

"Oh, yes, sorr, it went off all right, but the trouble was that it went off while I was asleep."

* * *

Dentist: Which tooth is it that hurts you, Sam?

Pullman Porter: Lower five, sah.

* * *

A college graduate is a person who had a chance to get an education.

* * *

Sales Director: Have you finished making up your sales map?

Saleslady: No; I can't find my compact.

First Crapshooter (rattling dice furiously): Shoots a dollah! Fade me, somebody, fade me!

Second Sportsman (producing a roll that would strangle a shark): Fade you—, Black boy, you'se bleached!

* * *

"Johnny, will you please tell the class what an octupus is?"

Small Boy: "It must be a cat with eight sides."

* * *

Definition of a farmerette:

The little girl that goes out on Saturday night and sows wild oats, then goes to church on Sunday morning and prays for a crop failure.

* * *

Foreman: Your noon hour's over. Didn't you hear that whistle to go back to work?

Worker: Yes, but I was waiting for the echo.

* * *

A storekeeper had his stock insured against fire and the same day his shop and all his merchandise were burnt up in a fire. This all seemed a bit unusual and the president of the company, to relieve his mind, wrote the storekeeper the following letter:

"Dear Sir: You took out an insurance policy at 11 a. m. and your store did not catch fire until 4:30 p. m. Will you kindly explain the delay?"

* * *

"Hello. Is this the Fidelity Insurance Company?"

"Yes, Madam."

"Well, I want to arrange to have my husband's fidelity insured."

* * *

"You call that a race horse? Can the nag really run?"

"Run? Why, that horse can stand still faster than most horses can gallop."

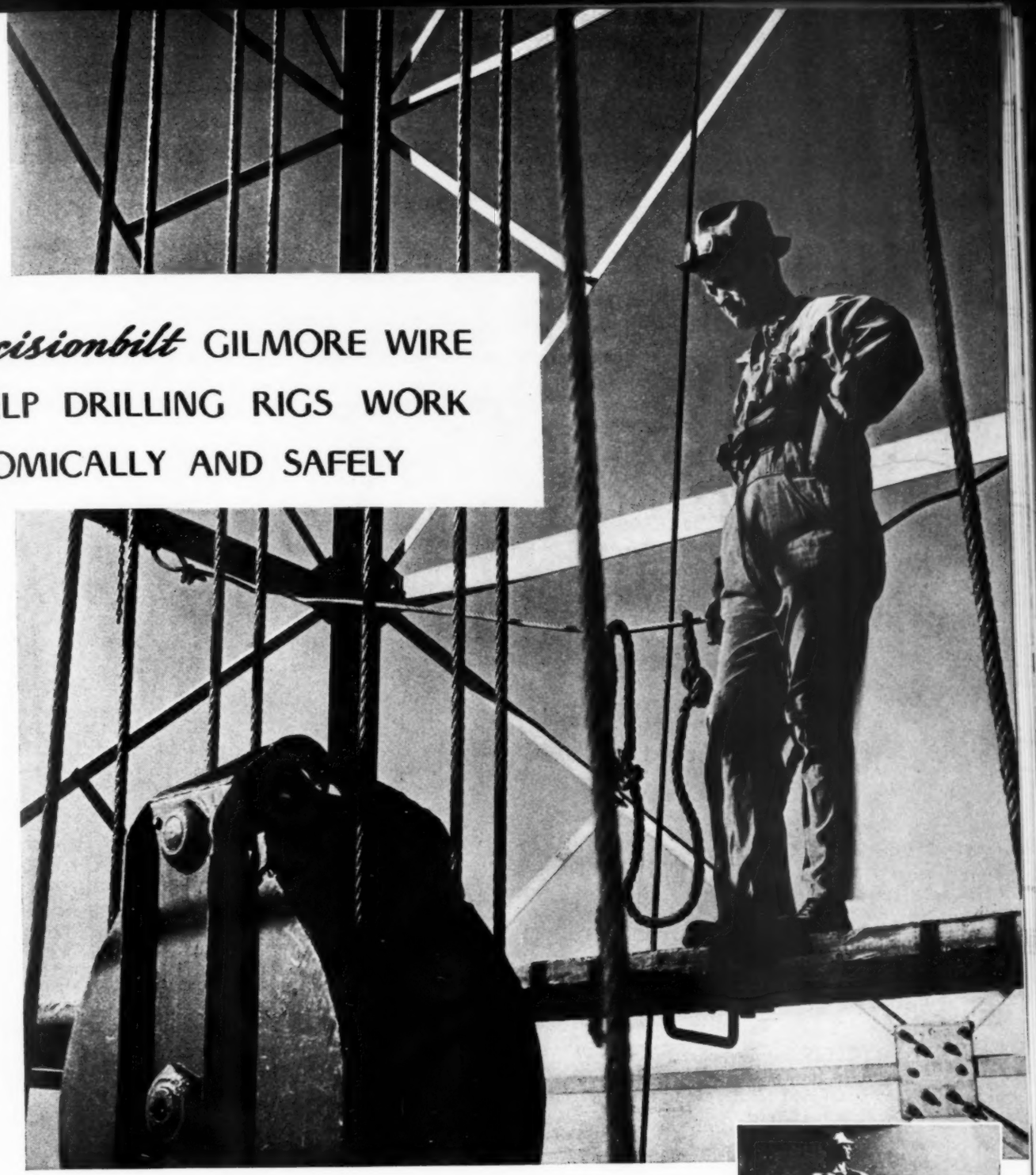
* * *

"Waiter, this is a very small steak."

"Yas, suh, ah spects it is."

"And it's very, very tough."

"Den it's suttingly lucky it's small, ain't it, suh?"



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When you equip your drilling rigs with J & L Precisionbilt Gilmore Wire Lines you can count on smooth, efficient, safe operation. Made of J & L Controlled Quality (CQ) Steel — on the newest wire rope making machines that work to tolerances of 1/1000 of an inch—these Precisionbilt products have the strength, flexibility and abrasion-resistance to stand up under hard, continuous service.

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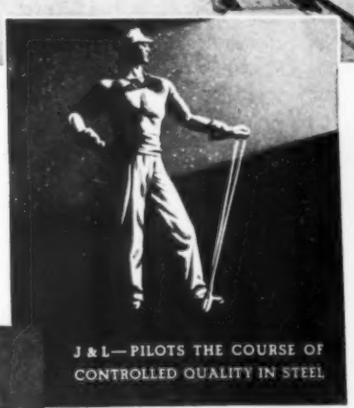

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J&L STEEL

J & L—PARTNER IN PROGRESS TO AMERICAN INDUSTRY

Running Tour
WITH MEN IN THE INDUSTRY

E. D. SMITH, who has been general superintendent of the producing department of the Magnolia Petroleum Company, making his headquarters in Dallas, Texas, has been made assistant manager in charge of drilling and production. He succeeds **CHARLES L. GLADDEN,** who resigned to become affiliated with a drilling contracting firm. **E. N. WILSON,** superintendent of the Oklahoma Division, becomes the new general superintendent, and **A. H. PROCTOR,** superintendent of the Stonewall district, Oklahoma, succeeds to Wilson's post.

E. D. WATSON, engineer with the Shell Pipe Line Company, has been transferred from Douglass, Texas, to Henderson, Texas.

J. F. SCOTT, an engineer on the staff of the Carter Oil Company, is now stationed at St. Elmo, Illinois. He formerly was at Fairfax, Oklahoma.

R. N. BILLS, engineer, Amerada Petroleum Corporation, is now making his headquarters at Lake Charles, Louisiana, having been transferred from Kinder, Louisiana.

C. ELLIS, superintendent for the Socony-Vacuum Oil Company, has been transferred from Temple, Michigan, to Byron Center, Michigan.

MARTIN HEAD, independent operator, active in Texas and Mexico, has opened an office at St. Joseph, Missouri.

H. W. NEWELL, a recent graduate of Harvard University, has been made assistant to **A. E. OLDHAM,** chief geologist of the American Liberty Oil Company, Dallas, Texas.

JACK SKAGGS, chemical engineer, Bariod Sales Company, has been transferred from Houston, Texas, to Tulsa, Oklahoma. He is conducting research work in the Tulsa laboratory.

MAX THORNBURG, vice-president of the California-Texas Oil Company, has returned to the United States after a brief business visit to London, England.

C. B. TRUITT has been made division manager for Hanlon-Waters, Inc., and transferred from Midland, Texas, to Fort Worth, Texas. He has been district manager at Midland. His new territory embraces Fort Worth, Dallas, Wichita Falls, West Texas, and New Mexico.

E. H. ROSS joined the staff of the Parkersburg Rig and Reel Company recently when that firm acquired the Smith Separator Corporation with whom he had been affiliated. He will reside in Tulsa, Oklahoma, and will be a sales representative for "Parkersburg-Smith Separators" as the product is now known.

W. A. THOMAS, consulting geologist, has been named chief geologist of the Michigan Division of the Ohio Oil Company. That company recently opened offices at Mount Pleasant. Thomas is credited with playing a leading role in the discovery of several Michigan oil fields.

ROBERT M. KLEINPELL, consulting petroleum engineer and geologist of Bakersfield, California, has sailed for Manila, Philippine Islands, to assist in determining oil production possibilities for the National Development Company.

R. D. MAY has been transferred by Gas Lift Corporation from the Arkansas-Louisiana-Texas area to the West Texas district to fill a vacancy created by the resignation of **LAMAR HUNT,** who has accepted a position as production superintendent with the Intercoast Petroleum Corporation.

A. L. ACKERS, division geologist at Fort Worth, Texas, for the Stanolind Oil and Gas Company, has been transferred to the company's Tulsa, Oklahoma, general offices and placed in charge of subsurface work in the exploration department. **FRANK H. SCHOUTEN** has been moved to Fort Worth from Midland, Texas, where he has been district geologist, and **FOSTER SCHEMPF** has been transferred from Tyler, Texas, to Midland.

ARNOLD HEGWER, engineer with The Texas Company, has been transferred from Fairfax, Oklahoma, to Sandoval, Illinois.

WALTER VAN NORMAN, vice-president of the Bankline Oil Corporation, now has his headquarters in Los Angeles, California. He formerly was at Houston, Texas.

W. E. GRAY, district drilling superintendent of the Lago Petroleum Corporation, has returned to Venezuela after spending some time in the United States. He was accompanied by Mrs. Gray.

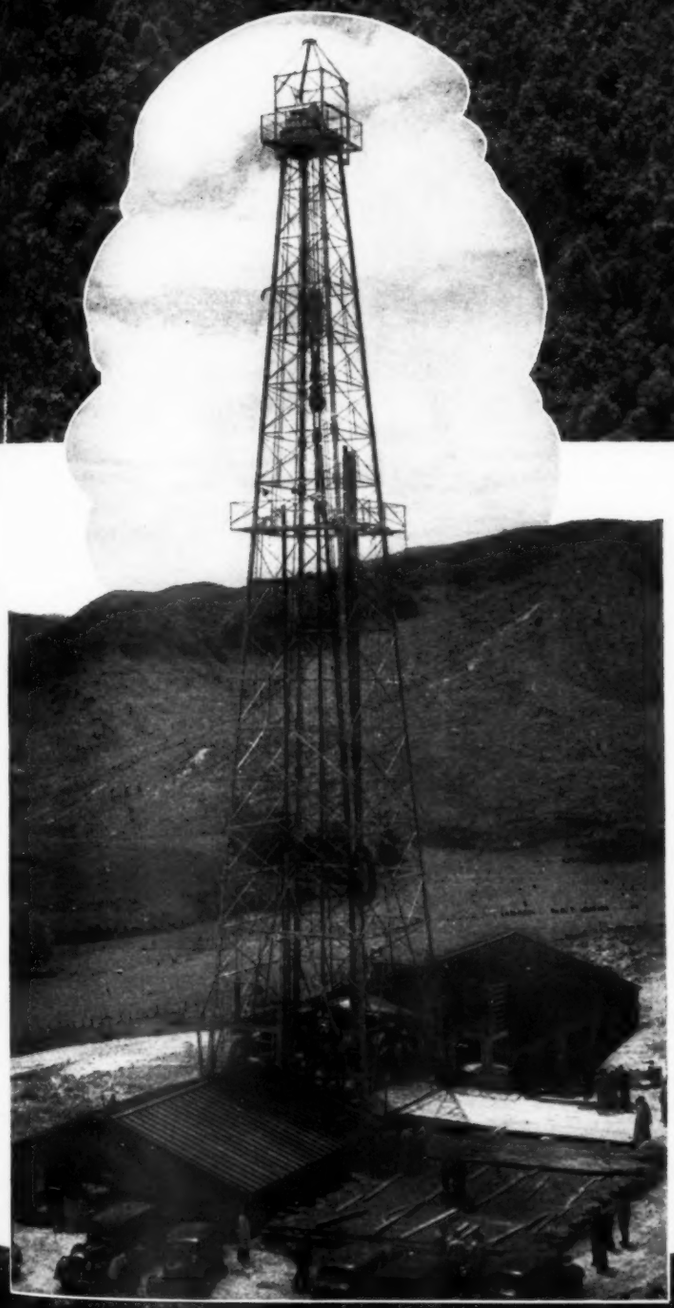
R. L. TOLLETT has succeeded **J. W. LANE** as secretary-treasurer of the Cosden Petroleum Corporation.

GLEN A. NELLE sailed for Venezuela recently where he will be assigned to drilling operations by the Socony-Vacuum Oil Company.

P. W. LAMBRIGHT has been named general manager of Romano-Americana S. A., to succeed **RALPH P. BOLTON.** The latter has transferred his offices from Bucharest, Roumania, to The Hague, Holland, in order to be more conveniently situated to supervise exploitation work in Europe and the Near East for the Standard Oil Company of New Jersey.

SIGNS OF CIVILIZATION AT THE END OF MANY A TRAIL

Because PARKERSBURGS *are Usually Picked to Drill "Problem" Jobs*



Did you ever notice the high percentage of remote wildcat locations that are drilled with Parkersburg Derricks . . . and, if so, did you ever stop to wonder why? Here's the logical answer:

When you've got a small fortune invested in a rank wildcat in one of those "end of the trail" places where anything can happen . . . and sometimes does . . . it's a grand feeling to know that your equipment is master of the situation. The operators of the Louisiana jungle location (above) and the New Zealand job (left) know their situation is well in hand, as far as derrick strength is concerned. And other operators in jungles, mountains, deserts, swamps and water locations the world over have that same feeling of satisfaction about Parkersburg Derricks. That's why Parkersburgs have been chosen to drill most of the world's deepest wells and other problem jobs where emergencies, common to abnormal drilling, are likely to occur.

The design and construction of Parkersburg Derricks call for a reserve strength far beyond their rated capacity. Furthermore, their ruggedness assures a longer working life in ordinary service.

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A-3-39

J. C. BRADLEY has been appointed superintendent of Anderson-Prichard Refining Company's Cyril, Oklahoma, plant. He has been with Winkler-Koch Engineering Company at Ploesti, Roumania.

H. E. PURDUM, tool pusher for the J. A. English Oil Development Company, is now making his headquarters at Fillmore, California. He has been at Glendale, California.

J. R. SHAW, chemist, Gulf Oil Corporation, has been moved from Longview, Texas, to Port Arthur, Texas.

F. C. HENDERSON, president of Henderson Company, is now making his headquarters at Skytop, Pennsylvania, having moved there from New York City.

L. L. HAINES has been appointed superintendent of production in the Clay City area, Illinois, by the Pure Oil Company to succeed **H. L. PATTERSON,** who has been transferred to Corpus Christi, Texas.

HOMER PIERSON and **W. P. LAUGHTER,** who have been in charge of the deputy supervisor's offices at Refugio, and San Antonio, respectively, for the Texas Railroad Commission, have changed positions.

FINLEY DOYLE, geologist for the Sun Oil Company, who has been stationed at Evansville, Indiana, is now located at Morganfield, Kentucky.

R. L. BABCOCK, driller with the Iraq Petroleum Company, was in California on vacation. He left recently to return to Kirkuk where he is headquartered.

W. D. SORRELLS, drilling engineer with the Lago Petroleum Corporation, is now in Texas after spending some time on vacation in California. He will shortly return to Maracaibo.

J. VISSER, tool pusher with Bataafsche Petroleum Maatschappii at Balikpapan, Borneo, with **MRS. VISSER** and their family, has been spending a vacation in Los Angeles, California. He is now on his way back to Borneo.

JOHN GALLEY has been named district geologist by the Shell Oil Company and transferred from the Tulsa, Oklahoma, office of the company to Wichita, Kansas. He succeeds **LESLIE M. CLARK,** who has been sent to Centralia, Illinois.

B. R. CUNNINGHAM, drilling superintendent for the Caribbean Petroleum Company, was a guest at a recent meeting of the Nomads in Los Angeles. In addition to giving some valuable information on selling equipment in Venezuela, he told of experiences with the Motolone Indians in the Colon District near the Colombian-Venezuela border. **MR.** and **MRS. CUNNINGHAM** have now returned to Venezuela.

NEVIN WALP, drilling superintendent for the Caribbean Petroleum Company, and **MRS. WALP,** have been spending their vacation in California.

R. L. TOLLETT has been named secretary-treasurer of the Cosden Petroleum Corporation, Fort Worth, Texas, to succeed **J. W. LANE,** who resigned to become secretary-treasurer of Motor Fuels, Inc. Tollett has been with the Wrightsman Oil Company, Fort Worth.

R. R. BUCKHAM, chief chemist, James B. Berry Sons Company, Oil City, Pennsylvania, has resigned to accept a position as vocational instructor in oil and natural gas at the Oil City High School.

J. NOORDUJAN, managing director of the Asiatic Petroleum Company in Curacao, Dutch West Indies, has returned to his headquarters after spending some time in the United States.

B. B. PARRY, assistant manager of Compania de Petroleo Shell de Colombia, recently sailed from the United States to return to his headquarters at Bogota.

W. L. FRANKLIN, research engineer at the Shell Oil Company's Martinez, California, refinery, has been made engineer at the company's Wilmington refinery.

WALTER G. MANESS has been made superintendent of the Matthews Refining Company's new plant at St. Louis, Missouri. He has been superintendent of the T. O. P. refinery at Gladewater, Texas.

IRA A. BRINKERHOFF has been appointed district geologist by the Stanolind Oil and Gas Company, making his headquarters at Houston, Texas. He has been on the geological staff at San Antonio, Texas. **R. S. WEINGARTNER,** whom he succeeds at Houston, is now on special assignments.

C. D. MARSHALL, chairman of the executive committee of the board of trustees of Koppers United Company, has resigned. To succeed him as chairman, the executive committee has elected **J. T. TIERNEY.** Tierney also continues as president and Marshall retains his membership on the Board. Tierney will also be chairman of the board of Koppers Company, resigning his position as president of this principal operating unit of the Koppers organization. He will be succeeded as president of Koppers Company by **J. P. WILLIAMS, JR.,** who for some years has been vice-president of Koppers United Company and president of The Koppers Coal Company. Williams will serve also as executive vice-president of Koppers United Company.

DR. BEN H. PARKER, instructor in the Colorado School of Mines, has been retained by the Argentine Government to make geological investigations. He has obtained a one-year leave of absence to undertake this work.

PARK J. JONES, engineer with The Texas Company, has been transferred from Long Beach, California, to Pampa, Texas.

J. F. SCOTT, engineer, Carter Oil Company, is now stationed at Carrollton, Illinois, having been transferred from St. Elmo, Illinois.

LUKE SIMS, president, Fields and Sims Company, has moved his headquarters from Mount Vernon, Illinois, to Birmingham, Michigan.

CHARLES K. SEAMAN, engineer with the Humble Oil and Refining Company, has been moved from Alvin, Texas, to Lake Charles, Louisiana.

V. K. BENSON, engineer, The Texas Company, is now at Houston, Texas. He has been stationed at Columbus, Texas.

C. L. MORGAN, geologist, has been transferred from Shreveport, Louisiana, to Tyler, Texas, by the Lion Oil Refining Company, as a result of that company closing its Shreveport office.

C. E. PATTERSON, Standard Oil Company of Venezuela, and **CHARLES SMITH,** Lago Oil and Transport Company, both of whom are personnel supervisors for their respective companies, have returned to their head offices after spending their vacations in the United States. Patterson is stationed in Venezuela and Smith at Aruba, Dutch West Indies.

JOE NETICK, manager at Maracaibo, Venezuela, for the Orinoco Oil Company, a subsidiary of the Pure Oil Company, is spending his vacation in the United States.

PETE BUHART, driller for California Arabian Standard Oil Company, has returned to Saudi Arabia after an extended visit in California.

TOM BARTON, of the personnel department of the Caribbean Petroleum Company at Maracaibo, spent a short time in Los Angeles, California, recently before returning to Venezuela.

HARRY STUBBS, drilling superintendent for Anglo-Ecuadorian Oilfields, Ltd., in Ecuador, is in Los Angeles, California, making a study of methods and equipment. He was a guest at a meeting of the Los Angeles Chapter of Nomads where he provided considerable information on use of American equipment in South American countries.

GAVIN WITHERSPOON, chief engineer for California Arabian Standard Oil Company, has been vacationing in California.

C. R. SCHWARTZ, production superintendent for Romano-Americana, is now in California on vacation.

H. W. SANDERS on August 1 became treasurer of the Union Oil Company of California to succeed **J. M. RUST,** retired. Sanders first became associated with the Union Oil Company in 1926 and was elected an assistant treasurer on August 27, 1934.

PAUL D. TORREY, of The Sloan and Zook Company, Houston, Texas, recently spent six weeks in Shreveport, Louisiana, on special work for his company.

JOHN H. MORAN, who has been district manager at Oklahoma City, Oklahoma, for the Shaffer Tool Works, Brea, California, is now in the export office of his company, Rockefeller Plaza, New York City.

W. H. REES, Atlantic Refining Company, Production Department, whose headquarters have been Overton, Texas, is moving to the Dallas office. He recently completed a study of gas-lift installations in West Texas and his new duties will be the supervision of all gas-lift installations on Atlantic properties.

W. T. GRANT has been made assistant chief safety engineer by the Humble Oil and Refining Company, Houston, Texas. He will act as assistant to **R. B. ROAPER,** chief safety engineer. Grant has been chief safety engineer in the refining department of the company and has been stationed at Baytown, Texas.

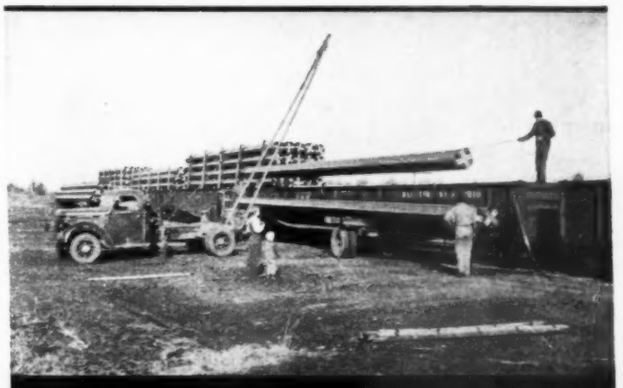
MICHEL TENAILLE and **HENRI VAUTRIN,** geologists of Compagnie Francaise des Petroles, which is associated with the French Government, are doing survey work in Venezuela for the company.

J. W. ANDERSON, Dallas representative of The Whitney Chain and Manufacturing Company, who has previously operated from his home, has now opened an office at 902 Allen Building, Dallas, Texas.

DR. H. T. MANN has accepted a position as professor of petroleum engineering at the Missouri School of Mines and Metallurgy, Rolla, Missouri, and will assume his new duties September 1. He has been a professor of petroleum engineering at Massachusetts Institute of Technology, Boston, for the last 13 years.

Cut

HANDLING COSTS



WITH 50-FOOT PIPE LENGTHS

● You'll shorten running time and cut costs all along the line by using Armco Spiral Welded Pipe in 50-foot lengths. These extra-long pipe lengths naturally mean fewer sections to unload, haul and string; fewer joints to weld in the field.

Then too, since Armco pipe comes in *uniform* lengths, bid prices are likely to be lower and cost estimates more accurate. This is because the pipe-laying contractor can base his estimate on the *exact* number of sections required, thus eliminating guesswork. Besides, contractors know from experience that they can field-weld Armco pipe faster and more economically than other types.

Added to these advantages you'll find Armco Spiral Welded Pipe low in first cost because the wide assortment of wall thicknesses (from 7/64 to ½-inch) enables you to select pipe exactly suited to your needs. Diameters range from 6 to 36 inches with a complete line of shop-fabricated fittings and optional coatings. For prices and firm delivery promises, just address: The American Rolling Mill Co., Pipe Sales Div., Middletown, Ohio; 538 Mayo Bldg., Tulsa, Okla.; 3500 Maury St., Houston, Texas.

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SPIRAL WELDED PIPE

LINE PIPE AND SURFACE CASING

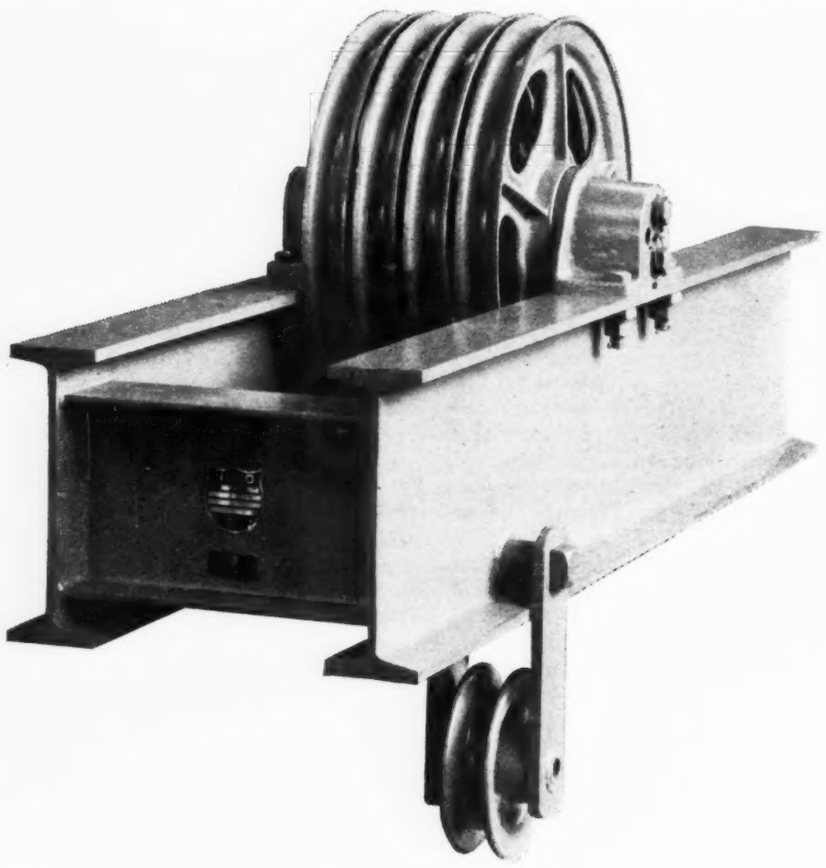
MACHINERY and EQUIPMENT

Ideal Crown Block

THE National Supply Company, Toledo, Ohio, has placed on the market a new rotary crown block for light rotary drilling. This block, known as the Ideal Type D-6, is a unit of improved design that is narrower and stronger in proportion to weight and operates with less friction and lower maintenance, the makers assert.

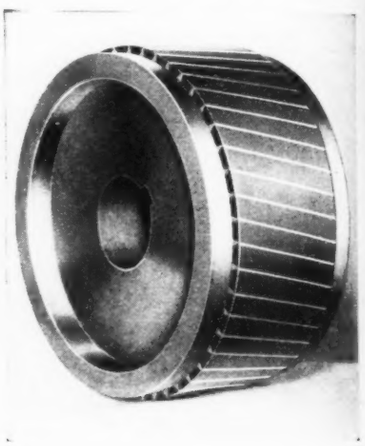
Spacers are entirely eliminated on this block by carrying each sheave in a double-row Timken roller bearing. This eliminates the continual friction and wear caused by spacer contact. Sheaves and bearings are completely self-contained assemblies without any side contact except that of the stationary inner races. The elimination of spacers has also resulted in a desirably narrower width and reduced shaft stress. In addition, as wear is entirely on the readily replaceable, hardened and ground outer and inner races of the Timken bearings, it is unnecessary to harden the surface of the shaft. This has made possible the use of a heat-treated alloy-steel shaft having a more desirable combination of strength and ductility, the manufacturers assert.

The main sheaves are of heat-treated steel. Rims are wide and spacing is close to prevent the wire line from fouling. The complete block may be hoisted into position or the shaft assembly removed as a unit. A 12-in. catline sheave is regular equipment. The diameter of the main sheaves is 30 in. The width with cat sheave removed is 27¼ in. and the net weight complete 2195 lb. Full details are given in Bulletin No. 241.



Copperspun Rotor

AFTER years of research and experiment, Fairbanks, Morse and Company have announced a new one-piece, centrifugally-cast Copperspun Rotor. Since the invention of the polyphase squirrel-cage motor, many different types of rotor construction have been developed in the attempt to produce a more perfect winding, and the demand in recent years for new and more difficult applications of squirrel-cage motors has emphasized the necessity of a rotor having greater mechanical strength and the ability to withstand higher temperatures.



The new Fairbanks-Morse rotor winding is manufactured of pure copper. The rotor bars and end rings are formed in one piece by pouring molten copper into a mold that encases the punched laminations, stacked and held under pressure. Copper is poured from one end only as the entire assembly is spun at high speed. The opposite end ring is formed by material that has passed through the rotor slots insuring a fluid material during the casting process. As a result of the centrifugal force, a tough, dense, ductile copper winding is produced with high strength, full slots, and uniform structure and conductivity, the manufacturer states.

After completion of the centrifugal casting of the one-piece copper winding, the rotor is machine-finished over all surfaces. This gives a true running rotor, it is asserted. Specially designed fans have also been developed for this new rotor.

Superior METALS in Jarecki products

In the modern Jarecki plant at Erie, we maintain strict laboratory supervision of the Physical, Chemical and Metallurgical properties of all materials used in the manufacture of JARECKI Valves, Fittings and Specialties.

MALLEABLE IRON

has 20% to 25% Higher Tensile Strength

All malleable Iron used in Jarecki products is melted in perfectly controlled powdered coal air furnaces which produce iron with 20% to 25% higher tensile strength and elongation than cupola malleable. Average physical properties are: Tensile strength, 52,000 lbs. per sq. in.; Elastic limit, 36,000 lbs. per sq. in.; Elongation in 2", 12½%.

CAST IRON SEMI-STEEL

are Close-Grained — Uniform

Jarecki Cast Iron Valves and Fittings are made from close-grained, uniform gray iron of the highest grade. Test bars are run from every heat. Average tensile strength is 25,000 lbs. per sq. in.

Our Semi-Steel has a considerably higher tensile strength than Cast Iron, making it particularly suitable for valves and fittings in which extra strength is required. Jarecki Semi-Steel has an average tensile strength of 36,500 lbs. per sq. in.

BRASS, BRONZE HARD BRONZE

are of Highest Quality

JARECKI Brass Valves and Fittings are made of a good grade of Red Brass, with a tensile strength averaging 28,000 lbs. per sq. in., and elongation averaging 15% in 2". JARECKI Bronze is a high-grade alloy having a tensile strength averaging 30,500 lbs. per sq. in. and elongation of 16% in 2". JARECKI Hard Bronze has a high tin content which imparts great strength and hardness. Tensile strength averages 35,000 lbs. per sq. in. Elongation averages 18% in 2". A special Manganese Bronze used for valve stems has a tensile strength of 70,000 to 78,000 lbs. per sq. in., while a special Nickel Bronze used for discs has a tensile strength of 45,000 lbs. per sq. in. and a Brinell hardness of 172 to 187.

Our strict supervision of metals is an important factor in insuring that JARECKI products will meet your most exacting requirements.

Fig. 395-X Iron-Body Gate Valve

Fig. 1896 Malleable Iron Ground-Joint Union

Fig. 57-H Heavy Oil Malleable Elbo

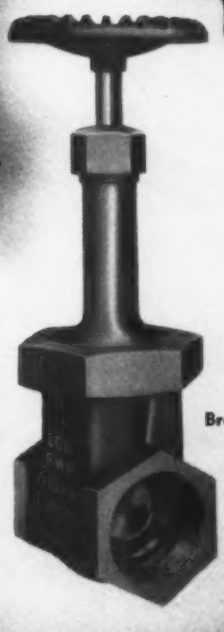


Fig. 481 Bronze Nickel Disc Gate Valve

Jarecki

MANUFACTURING COMPANY

"Since 1852"

General Offices: St. Louis, Mo. Home Office and Factory: Erie, Pa., U. S. A.

District Offices: Pittsburgh, Pa.; Tulsa and Bartlesville, Okla.; Dallas and Houston, Texas; Mt. Pleasant, Mich.; Centralia, Ill.

Branch Stores at All Important Places in the Oil Country.

Double-Beveling Dished Tank Heads

A FIRM that formerly purchased dished heads and flat sheets already beveled for the welded fabrication of fuel-gas tanks, has found that their welding shop can perform the beveling operations at a saving by means of portable machine cutting, according to the Linde Air Products Company, New York City. This job is of particular interest as it illustrates an interesting setup that can be used effectively for double-beveling dished heads of virtually any size.

This close-up shows the outside beveling operation in progress

As the flanges of these tank heads were to be beveled on both the inside and outside, it was necessary to use two different setups. First, a circular plate was cut to slightly less than the inside diameter of the tank heads so that the cutting machine would have a suitable surface on which to travel. This plate was necessary because the height of the flange made it impossible for the cutting machine to ride directly on the dished head. The plate was then supported so that it was approximately level with the flange edge. Next, the plate was center-punched and the cutting machine set in position, using the standard radius rod.

A standard setup consisting of an Oxweld portable cutting machine, Type CM-16, equipped with a bevel-cutting adaptor was used for making the outside bevel. In the second setup for cutting the inside or inverted bevel, however, it was necessary to replace the bevel-cutting adaptor with a heavy-duty cutting attachment.

"Mijit" Drill Jig

THE new Esco "Mijit" drill jig, designed to meet requirements of small parts manufacturers, weighs less than 6 lb.; working areas range from 1¼ in. by 2¼ in. in the smallest type to 3 in. by 3 in. in the largest type, and positive lock is provided, the manufacturer asserts.

Four distinct models are involved, incorporating a standard lift of 1 in., as well as varying locations of guide posts. The locking device can be adapted to other than the four standard jigs.

When used as a drill jig, drill bushings are placed in the top plate and work-holding units are fastened to the underside of the top plate and the upper face of the base plate, thus properly locating work in relation to drill bushings. Use of holding units also makes more positive the pressure and grip on the part being worked.

Manual operation of the black bakelite knob fastened to the end of the

YOU CAN'T BEAT 'EM *for* SMALL PIPE & BOLTS

"TOLEDO" No. 00 ⅛ TO ¾ INCH PIPE
5/16 TO 1 INCH BOLTS

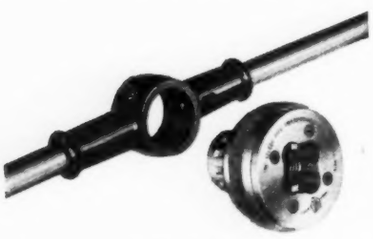
"TOLEDO" Small Ratchet Threaders No. 00 for ⅛" to ¾" Pipe and 5/16" to 1" Bolts, No. 11 for ⅛" to 1¼" Pipe and ½" to 1" Bolts, No. 12 for ⅛" to 2" Pipe and ⅞" to 1½" Bolts are ideal for the smaller sizes.

Separate die head and dies for each size assures instant die change and smooth, standard taper threads. Segmental dies are easily removed and reground or replaced at small expense. Die heads are strong and sturdy with ample chip clearance. Ratchet parts are large and enclosed. Handles are light, tubular and of ample strength.

Adjustable die heads can be furnished for the No. 00 model. Adjustment of 4 to 5 turns on pipe and 1/64" on bolts. Simple, quick, positive adjustment. Two types of handles either ratchet or straight two handle stock as desired. Steel carrying cases in two sizes also available.

Send for the complete "TOLEDO" catalog today—no obligation.

DON'T FORGET THE "TOLEDO" ADJUSTABLE PIPE AND BOLT DIE HEADS

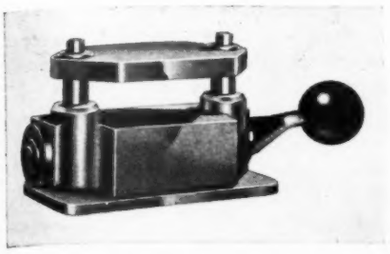


THE TOLEDO PIPE THREADING MACHINE COMPANY
TOLEDO, OHIO
NEW YORK OFFICE, 72 LAFAYETTE STREET

"TOLEDO"
TRADE-MARK REGISTERED

YOU'LL DO BETTER WITH A "TOLEDO"

steel arm operates the jig. Benefits asserted are increased production by



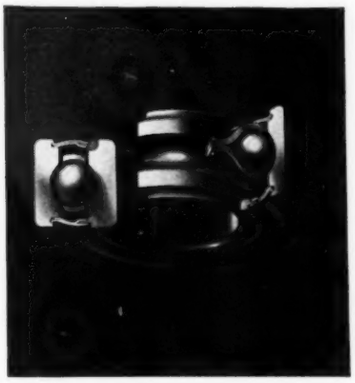
quicker loading and unloading time; less operator fatigue, and reduction of rejections due to imperfect work.

The equipment is manufactured by Esco Engineering and Sales, Inc., 4612 Woodward Avenue, Detroit, Michigan.

SKF Develops New Felt-Seal Bearing

A LINE of sealed ball bearings embracing new principles has been developed by SKF Industries, Inc., Philadelphia, Pennsylvania. This development departs from the conventional stuffing box type of seal by employing felt fiber contact on the polished surfaces of the inner race to seal against dirt, and by the utilization of the natural tendency of deflected felt to resume its original flat shape.

The new seal retains the bearing lubricant and excludes dust or dirt from the bearing, yet the sealing action is so light that the friction drag has been greatly reduced, it is stated.



The bearing is, therefore, suitable over a great range of speed. Even though the bearing is in the standard single row width, which in itself simplifies design and saves space, an ample lubricant space is provided, as is indicated in the accompanying illustration. It is called the SKF Red Seal Bearing. Its designation is 6200 RS, and it is available for shafts to approximately 1 in. in diameter.

Combination Casing Hook

A CASING hook to carry a full load of 300 tons with a large safety factor has been developed by Regan Forge and Engineering Company, San Pedro, California. It is a combination hook embodying two separate load-carrying elements. The lower hook carries the swivel bail and the upper yoke is designed to carry the elevator links. The cross-yoke is slidably mounted. When the load is applied the yoke travels downward and rests upon the main hook.

The newly engineered hook is either forged or cast of alloy-steel and is fully heat-treated to develop maximum physical properties. To permit free swiveling, a heavy-duty anti-friction roller bearing is embodied.

RIDE 'EM—DRIVE 'EM—TEST 'EM—*Anywhere—Anytime*

You'll Swear By "CLEVELANDS"—*Not At Them!*

WATCH YOUR COSTS GO DOWN

Your next job may be on the prairie—or in the mountains—in sticky gumbo—or in rocky ground. It may be a new line — gathering lines or a reconditioning job.

No matter where — put "Clevelands" on the line and you'll get maximum performance at lowest operating cost.

"Clevelands" are soundly engineered equipment, ultra modern in design, built to "take it" and meet conditions as they are.

From the husky, amply-powered Diesel or Gasoline engine to the high-capacity digging wheel, you'll find, in every "Cleveland", toughness, freedom from friction and protection against wear, to an unrivaled degree.

Every operation incidental to mechanical ditching has been speeded up — waste motion done away with — dead weight and unnecessary bulk eliminated. Most usable, most efficient, you'll find "Clevelands" the kind of ditcher that it's a satisfaction and pleasure to own and operate . . . Get specifications and details today.

THE CLEVELAND TRENCHER COMPANY

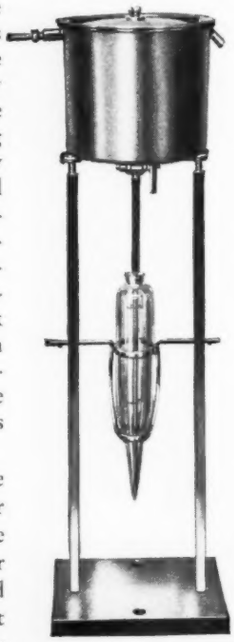
"Pioneer of the Small Trencher"

20100 St. Clair Avenue **Cleveland, Ohio**

And another mighty important Cleveland feature — Truck Speed Transportation on special Trailer — Machines loaded and unloadad in 10 to 15 minutes.

Constant Head Elutriator

THE new A.P.I.-approved Elutriator of the Baroid Sales Department, National Lead Company, Los Angeles, California, for determining the percentage of sand entrained in a drilling mud incorporates several new features. The most important change from previous designs is in the water reservoir, which is now provided with a water inlet and outlet, or overflow tube, for maintaining a continuous flow of water and a constant head on the mud being tested. This is essential, particularly for those muds that are at least partly flocculated, because they require considerable washing before the clay and sand separation is effected.



Analyzing the sand content is important because excessive sand may cause considerable damage to drilling equipment by abrasion and will impair the wall-building properties of a mud, resulting in deposition of a thick filter cake and a consequent interference with the passage of tools and casing.

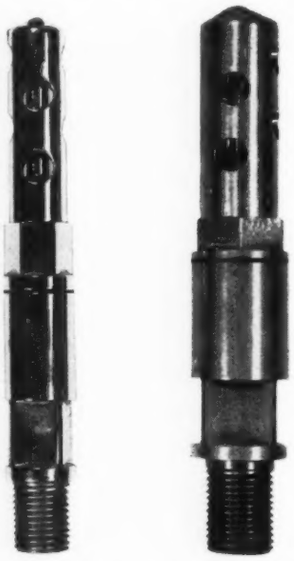
The principle of the Elutriator is based on the ability of water flowing at a fixed rate to transport grains of insoluble material that does not exceed 200 mesh. All materials coarser than this mesh remain in the tube and represent the amount of abrasive sand in the drilling mud. The percentage by volume is read directly from the scale engraved on the glass elutriation tube.

A stopcock directly beneath the reservoir restricts the initial flow rate of the water. If the water were allowed to enter the tube at full force at the start, the rate with which the colloidal material would be carried away would be so great that some of the abrasive sand also would be carried away.

The new Elutriator, except for the rubber jet tube connection and the glass elutriation tube, is constructed of Duralumin and has an alumilite rust-proof finish.

Well Temperature Recorder

MARTIN-DECKER Corporation, Long Beach, California, has announced the development of a device for measuring oil-well temperatures.



The Radium Recording Thermometer is available in two sizes: 1½ in. (right) for use with a circular type chart, and 1¼ in. (left) for use with a strip type chart

Known as the Martin-Decker Radium Recording Thermometer, this instrument gives a permanent record of well temperatures at any point in the hole, it is stated. The thermometer charts complete information on well temperatures at all depths during one run.

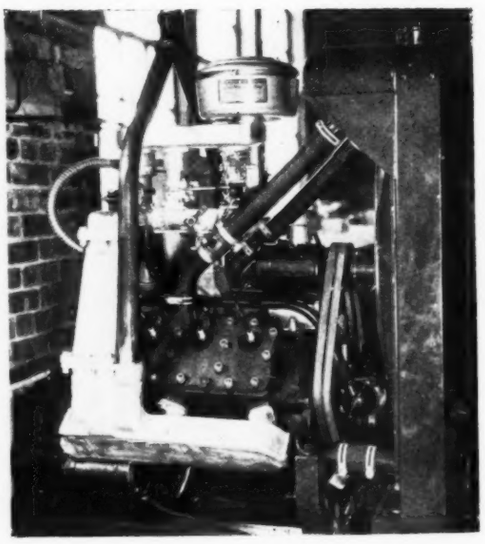
The recording thermometer features the use of a radium-tipped pointer that charts a record of heat variations as it moves over a sensitized paper chart. The pointer is actuated by an extremely sensitive, accurate thermal element that expands and contracts with variations in heat, thus moving the pointer around the chart. The pointer provides a friction-free method of operation, as it does not contact the chart.

Field and factory tests have proved this instrument to be accurate within one-half of one degree at all temperatures, the manufacturer states. It can be used on any drilling or producing well, is small enough to be run inside "spaghetti" tubing, and can be operated successfully by anyone familiar with equipment of this type, it is pointed out.

Further information can be obtained by writing to Martin-Decker Corporation, Long Beach, California.

Oil Conversion Unit

THE Dieselair, oil conversion unit, allows the Ford V-8 85-hp. and 95-hp. engines used for industrial prime movers to successfully and efficiently operate on standard tractor distillates and fuel oils, according to the manufacturer, Deiselair Corporation, First National Bank Building, Miami, Oklahoma. The Dieselair is now operating on portable oil-well rotary drilling rigs, electric arc welders, water, gasoline, and crude oil line pumping units. It is adaptable for oil-field equipment of many descriptions that use Ford V-8 engines as prime movers. The unit operates on normal engine temperatures of 160° to 180°.



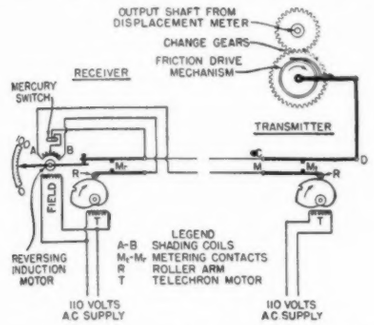
The Dieselair is comprised of nine semi-steel castings, an oil carburetor, connecting oil line to engine fuel pump, a three port aluminum air manifold, a standard electric fuel pump for gasoline carburetor on engine, a special rotary valve of simple construction, an automatic secondary air injector valve, a special crankcase oil-water condensation sludge eliminator, complete set of bolts, nuts, gaskets, etc., for installation.

In installing the Dieselair no changes are made in the Ford V-8 motor block. The spark plugs, the entire ignition system, carburetors, oil, and gasoline are removable without removal of the Dieselair unit. Two independent gasoline and oil fuel-air systems are controlled simultaneously by one rotary valve operation, which systems have one common standard throttle control, or any standard governor control.

Flow Recorder

A NEW flow recorder, operating to indicate and record instantaneous values of rate of flow as measured by displacement meters, has been developed by Bailey Meter Company, Cleveland, Ohio.

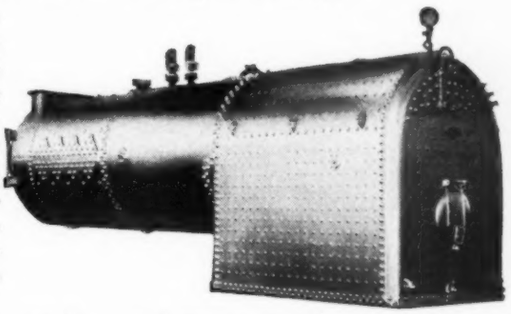
This device, which employs the Bailey Synchro-Meter electrical transmitting method, differs from the usual flow recording attachment for displacement meters in that it draws a graph of rate of flow against time instead of simply recording total flow over a given time, the manufacturer



asserts. It is attached to the displacement meter body by flange bolts. The displacement meter register is raised by a filler block to afford room for bevel gears and a short shaft extension is used to drive the register of the displacement meter. The bevel gears drive a shaft that operates the Synchro-Meter unit. No change or modification of parts of the displacement meter is required for the attachment of the Synchro-Meter device.

Lucey Announces "Largest" Boiler

LUCEY Boiler and Manufacturing Corporation, Chattanooga, Tennessee, has announced what they state is the largest boiler on the market, containing all exclusive features of other Lucey boilers, but having a larger firebox and greater heating surface, and a comparable reduction in weight, owing to construction and material used.



The new Lucey 150-hp., 350-lb. working-pressure boiler has a rivetless firebox that is 60 in. by 72 in. by 96 in. and a firebox heating surface of 178 sq. ft. and a volume of 233 cu. ft. By using high-tensile-strength steel, the boiler, despite its size, weighs only 36,500 lb. It is made with or without dome. Other features of the boiler are:

1. Seamless fire box, Lucey patent; no rivets to overheat or burn; no leaky seams.

2. 20 in. between crown sheet and outside wrapper; ample steam space and two gauges of water, easily compensating for the absence of the dome.

3. Arched crown sheet, large corner radii; good staybolt threads; stronger construction; easy cleaning; improved combustion.

4. Short tubes (13 ft.) in vertical rows; effective heating surface.

5. 4-in. water space all around the firebox; good water circulation.

6. Rating, A. P. I., 150 hp.

The new "Hi-Tensile" oil country boiler will also be manufactured in 250-hp. and 300-hp. sizes.

RECONDITION YOUR PIPE LINES FOR EXTENDED LIFE

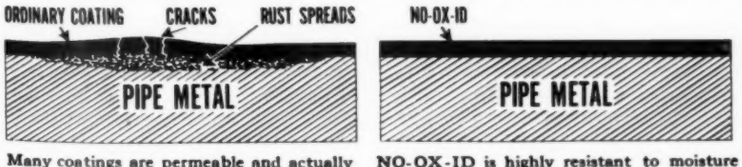
Applying NO-OX-ID by hand in wintertime. NO-OX-ID may also be applied by stationary or traveling type machines. It gives positive protection.

NO-OX-ID can be applied cold, by hand or hot, by machine

You can end pitting and corrosion on your pipe lines quickly and economically with NO-OX-ID and NO-OX-IDized wrappers. These coatings are available for cold hand application or hot application with stationary or traveling type machines. What's more, NO-OX-ID can be easily applied at all temperatures.

NO-OX-ID penetrates to the seat of the pits, where it stops all active corrosion by chemical action. Furthermore, as NO-OX-ID is naturally moisture repellent and cannot crack or lose its bond, it is suitable for all soil conditions. Dearborn will be pleased to make soil surveys and other tests to determine combinations of NO-OX-ID and NO-OX-IDized wrappers best suited to your needs. Write Dearborn Chemical Company, Dept. L, 310 S. Michigan Ave., Chicago.

RUST IS KILLED CHEMICALLY UNDER THE NO-OX-ID COATING



Many coatings are permeable and actually absorb moisture. Often they crack and admit corrosive elements. As a result, there is rapid corrosion under the coating.

NO-OX-ID is highly resistant to moisture penetration. It maintains a plastic, bonded coating that cannot crack. Chemical inhibitors check all under-film corrosion.

NO-OX-ID
IRON + OX = RUST
TRADE MARK
The Original Rust Preventive

Photo-electric Cell Equipment Used to Control Bessemer Converters

THE Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania, has made application for patent rights covering a method using photo-electric cell equipment in the operation of its Bessemer converters.

This scientific control constitutes a basic improvement in Bessemer practice, and is one of several methods on which patent applications have been made by Jones and Laughlin, it is stated. It is the result of several years' intensive work on the part of the J and L Metallurgical Department.

The new method, known as the "Bessemer Flame Control" has proved highly successful in achieving uniformity of quality in Bessemer steel, an objective long sought by the steel industry, it is asserted.

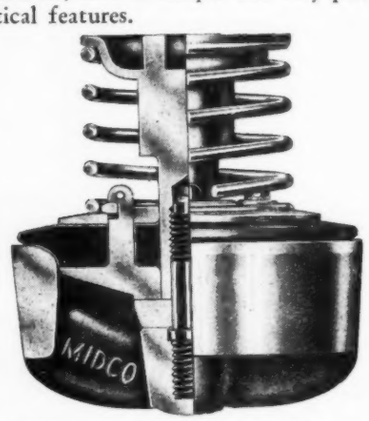
This precision control has an arrangement of photo-electric cells as the actuating element. In conjunction with the cells and as a part of the control system, a complete instrument panel provides accurate regulation of blowing conditions.

Until now, control of the Bessemer converter depended upon the skilled eyes of the blower, who had sole responsibility in determining the proper "end point" or termination of the blow, which has a definite connection with quality results. The object of the research was to supplement the skill of the human eye with an invariable method that would not be affected by fatigue, inattention, poor physical condition, or other variables that affect the most skilled eyes at times.

It is believed that this method of aiding J and L Blowers in their flame control decisions by precision equipment will develop new applications for Bessemer steels where uniform high quality steel is required.

Midco Slush Pump Valve

THE Midco Tool and Supply Company, Oklahoma City, Oklahoma, has introduced a new slush pump valve that is a self-contained mud-pump valve, embodying, according to the makers, several unique and very practical features.



Compact and having but few parts, the valve is light in weight yet is rugged in construction, it is asserted. The curved seat face is designed to reduce the cutting action of fluid and assure longer service from the valve. In tests, it is stated, Midco valve seats have made 80,000 to 90,000 ft. of hole with no appreciable wear; valves are thoroughly renewed by replacing impact washers and top assembly. There is a uniform opening of all valves, which is controlled by a sleeve nut. This is said to eliminate valve cap guide wear and permit smoother operation of the pump.

Parts for any one series are interchangeable with all makes of pumps. The valve is also made for all popular types and sizes of slush pumps, and is available through regular sources of supply.

"A BEAR FOR WEAR"

THERE IS ONLY ONE
GRIZZLY
LINE OF OIL FIELD PRODUCTS

"GRIZZLY"
Rotary Brake Blocks
Brake Block Band Exchange
Brake Lining
Belting
Rotary Hose
Rotary Hose Couplings
Drill Pipe Protectors
Wire Line Saver
Wire Line Turn Back
Flexible Discharge Unit

All products manufactured by this company are marketed under the one registered trade name—GRIZZLY. No other trade marks or trade names of any character are utilized. This company is not affiliated in any way with any other company manufacturing or marketing oil field specialties. All Grizzly products are the finest that it is possible to produce—the result of more than twenty-five years of specialized experience in this particular field—assuring users of maximum efficiency, economy and dependability in service. To be sure of obtaining genuine Grizzly products, always specifically state or write the name Grizzly when ordering.

E. M. SMITH COMPANY
600-650 South Clarence Street Los Angeles, California, U. S. A.
Complete Stocks Maintained in Our Warehouses at: 1121 Rothwell St., Section 16, Houston, Texas. 1008 S. E. 29th St., Oklahoma City, Okla. *Export Office:* Continental Emsco Co., 30 Rockefeller Plaza, New York City
Distributed by Leading Supply Companies

Eastman Casing Whipstock

THE Eastman Oil Well Survey Company, Dallas, Texas, announces an improved casing whipstock designed to set in casing to mill a window through any grade of casing for sidetracking, deflecting, or straightening a cased well.

The Eastman Whipstock has a long tapered face, a setting tool tube entering and passing downward through the face to a left-hand threaded connection on the lower section. To put into operation it is made-up on the drill pipe by the setting tool. It may be oriented into the hole, and when between casing collars at the desired depth, the drill pipe is filled with fluid and the arresting ball dropped, stopping downward circulation. Pump pressure is applied, and the piston being forced downward drives the pins outward into the casing. When the pins are driven, the piston passes the lower bypass openings, allowing circulation to be regained and locking the pistons and pins into place.

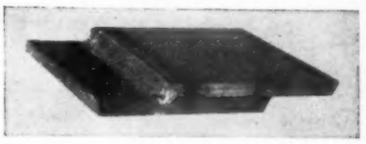
The drill pipe is rotated to the right and the whipstock is released from the string of drill pipe. A mill, preferably a core mill, is then put on the drill pipe and a "window" is milled-out of the casing.

The Eastman whipstock uses no shear bolts, springs, or slips and does not require bridges or plugs on which to set or land. It is set firmly and securely by hydraulic pressure. The long taper of the whipstock aids milling and gives a gradual deflection through the casing window, according to the manufacturer.

Glyptal Gray

GLYPTAL 1294 Gray, a recent addition to General Electric Company's line of welding accessories, was developed to supply fabricators with a material that, when applied to metal to be lap welded, would prevent corrosion at the point where the plates overlap. It is a pigmented version of the previously announced Glyptal 1294 Clear and will, like the latter, prevent the adhesion of weld spatter when applied to parts before welding, the manufacturer states. On lap welds it will prevent corrosion at the overlap. At the same time it serves as an excellent base for painting.

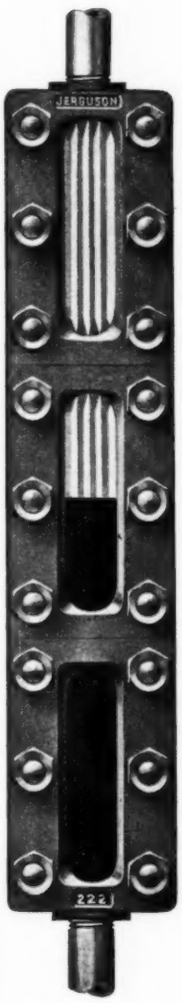
Glyptal Gray can be sprayed or brushed and the work can be left ex-



posed to the atmosphere until fabrication is complete with the assurance that edges of the parts will not need cleaning before the final welding operation, it is stated.

JERGUSON

REFLEX GAGES



are preferred by the Oil Industry because of their reputation for maximum efficiency at all temperatures and pressures.

Easy to read because the . . .

EMPTY SPACE SHOWS

WHITE

LIQUID LEVEL APPEARS

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Ideal for tanks, towers, stills, etc., carrying gasoline, kerosene, oil, no matter what the color of the liquid.

Furnished with or without valves for every type of service.

When you need to show the color and density of liquids, use Jerguson Transparent (through vision) Gages.

There's a JERGUSON GAGE for your plant

JERGUSON GAGES are best by every real test

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89 FELLSWAY

SOMERVILLE MASSACHUSETTS

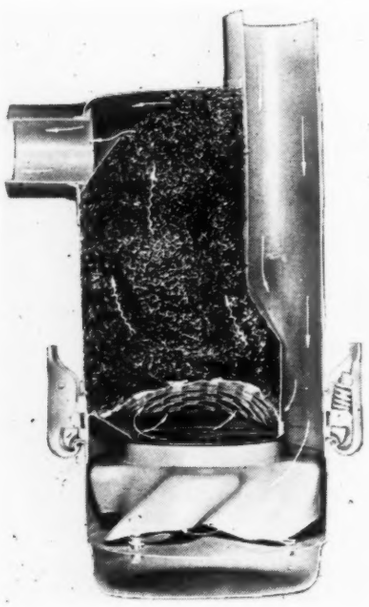
Oil-Bath Air Cleaner

AN oil-bath air cleaner for small and medium-sized equipment is announced by the Vortox Manufacturing Company, Claremont, California. It is made in two types, the Type R and the Type S.

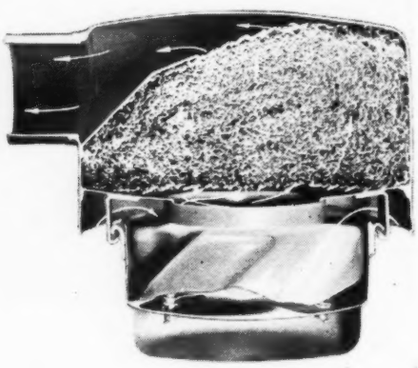
The air, made to whirl rapidly as it enters the cleaner, produces a vortex action, and picks up oil from the oil reservoir, spraying it on the impingement surfaces of the vortex chamber and into the filter element, thoroughly washing it of dust. Thus, air entering a Vortox Air Cleaner is first subjected to the cleaning action of a vigorous oil spray and a strong centrifugal action before it can enter the filter for final cleaning. Oil drains from the filter element and carries the small amount of dust entrapped downward into the oil reservoir.

The air inlets of these two new type cleaners are submerged in oil, thereby greatly increasing the vortex action at low-velocity air flow. Oil is carried into the filter element by the first revolutions of the engine.

The principal difference between the Type R and Type S cleaners is that the Type R takes air in through a vertical inlet stack and the Type S admits air over the edge of the cup. When it is desired to extend the inlet of the air cleaner to reduce the dust load or when chaff or fibrous materials are encountered, the Type R is recommended by the manufacturer. A feature of the Type R is a removable prefilter at the entrance to the filter element. This prefilter catches chaff, fibers, etc., and is easily cleaned. For general operating conditions, the Type S should be specified, it is stated. Its wide range of operation at high efficiencies makes it extremely valuable to the manufacturer in reducing the number of models of cleaners required to adequately protect his equipment, the makers assert.



Type R



Type S

Tommy's Vacuum Pump

TOMMY'S Vacuum Pump, an auxiliary unit said to increase recovery of oil from wells, is being manufactured by Frank Mathey Machine Works, 315 East 4th Street, Tulsa, Oklahoma. The pump is a double-acting unit giving constant and uniform vacuum to the well and pulling a vacuum of 20 to 26 points, the exhausts being tied together so that the gas may be reclaimed for regular use.

The unit may be installed on jack, beam, or other type pumping equipment. Made in two sizes, the 8-in. pump will displace 50,000 ft. of gas; the 12-in. size will displace 100,000 ft. of gas. With the vacuum attached directly to the well through special vacuum hose connected with tubing tee, the pump has doubled or tripled the production on many wells, the manufacturer asserts. The pump is supplied complete with unbreakable oil cup, 6-ft. of special vacuum hose, and connecting joint for either jack or beam type pumping equipment.

Tank Car Outlet Valve

MOST of the difficulties encountered with tank car outlet valves can be traced to two main causes: corrosion, scale or other foreign matter on the seat, and breakage caused by workmen forcing the valve past its proper seating position. The presence of scale and the forcing of valves often go hand in hand. The scale holds the valve open and the workman tries to force it closed.

In addition to the possibility of causing breakage, scale and corrosion may cause a valve to stick or freeze in action. When this happens the liquid in the car must be removed through the dome, an expensive and wasteful process.

The prevalence of these failures led to the development of a new valve by George Valve Company, Saegerstown, Pennsylvania. Corrosion of the valve parts is obviated by the use of virgin bronze, thus eliminating freezing. Virgin bronze is also used throughout to prevent corrosion by galvanic action.

The presence of scale or other foreign matter between valve face and seat is eliminated, first, by sealing the face of the valve while open and, second, by providing a wiping action that cleans the seat of scale every time the valve is closed. These two advantages are obtained by the use of two neo-

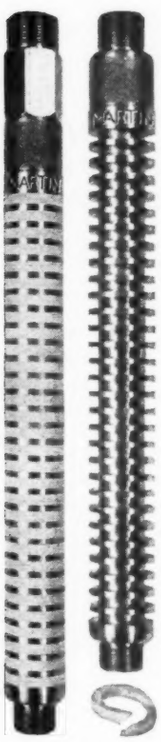
prene parts. These neoprene parts are essentially rings surrounding the face of the valve disk when in the open position although the lower one is webbed across the base of the disk.

Neoprene, du Pont's chloroprene rubber, was used for these rings because it was necessary to employ a resilient material that would resist deterioration from contact with chemicals and petroleum derivatives, the liquids commonly carried in tank cars.

The application of the neoprene rings has eliminated the practice of overforcing the valve. As the seat is always clear of scale it is not necessary to force the valve to close it tightly. Nevertheless the design includes another innovation that is planned to do away with breakage even though the workman uses unnecessary force. The basic principles included in this design are compression seating instead of grind seating and a free wheeling action. The application of compression seating makes the free wheeling action possible, but it also eliminates scoring of the valve face by the grinding action, it is asserted.

Martin Plunger Now Made in All Sizes

THE Martin Plunger, by John N. Martin, manufacturer, 11 West Brady, Street, Tulsa, Oklahoma, is now made to fit all sizes of tubing and rod pumps. This plunger is machined from one piece of metal and has no loose spacers or washers. The packing rings are split for mounting in the grooves and the swelling characteristic of the rings is employed to tighten the rings in the grooves and seal the cuts.

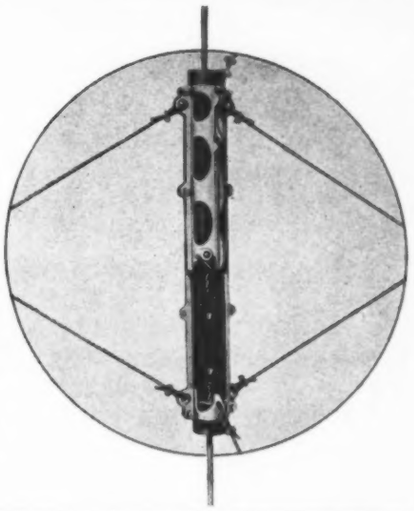


Martin Plungers are made in sizes from 1-in. to 4¾-in. diameter and in various lengths, the minimum recommendation being one ring per 100 ft. of well depth of lift. Rings are made in various undersizes to provide the proper working fit for different kinds of well fluid.

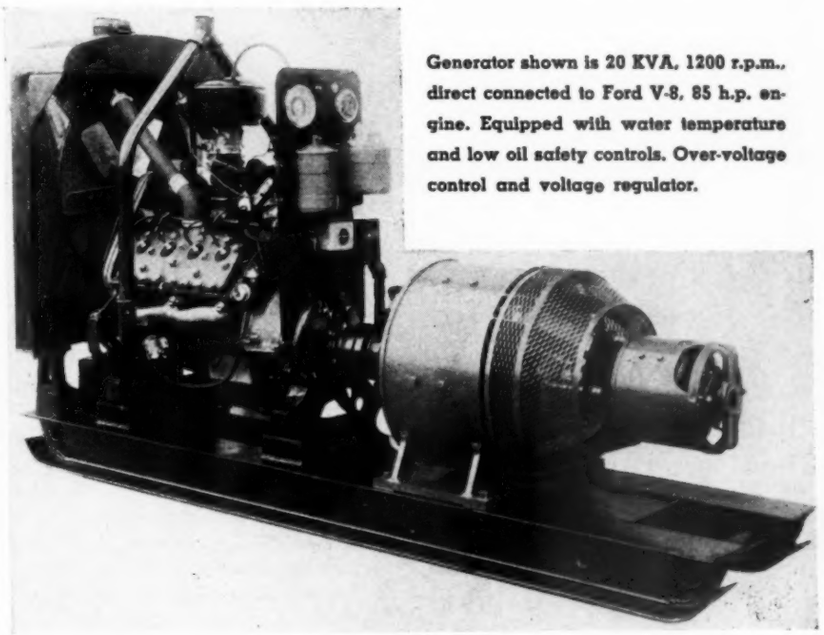
The one-piece body construction provides rigidity when pumping against high heads or pressures and eliminates passage of fluid beneath the rings. Among the advantages asserted are long wearing life for the rings, small wear on the working barrel or tube, lighter rod loads, and comparatively small initial and upkeep cost.

Small Wire Line Guide

THE accompanying illustration is of a new wire line guide that has been added to the line of the Patterson-Ballagh Corporation, Los Angeles, California. This type uses two small rubbers and ready for delivery weighs but 35 lb. The company's line of wire line guides now ranges from this small unit to a six-section type used on heavy rigs.



Dependable, Low Cost Electric Power . . . . .



Generator shown is 20 KVA, 1200 r.p.m., direct connected to Ford V-8, 85 h.p. engine. Equipped with water temperature and low oil safety controls. Over-voltage control and voltage regulator.

GENERAL POWER GENERATOR SETS

These generator sets are built to furnish 24-hour service, without the constant attention of an operator.
General Power Generator sets are available: as direct connected units, 20 KVA, both 3 and 1 phase; and 25 KVA, both 3 and 1 phase. Belt driven generators, of various size, driven by one to six Ford V-8 or Lincoln-Zephyr engines. Either D-C or A-C units are available.
On a 20 KVA direct connected unit, running on natural gas at 30 cents per thousand cu. ft., cost per KW is six-tenths of a cent.

For prices and information — Write, Wire, or Phone

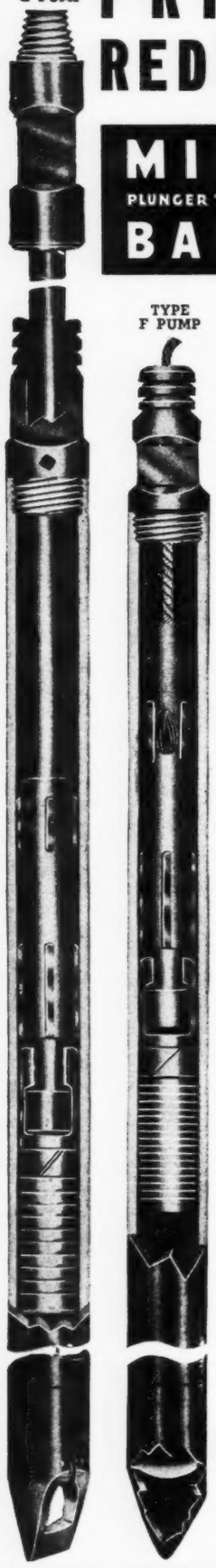
GENERAL POWER, INC.

QUAPAW, OKLAHOMA PHONE 64

TYPE G PUMP

PRICES REDUCED

MIDCO
PLUNGER TYPE CLEAN-OUT
BAILER



TYPE F PUMP

Now you can buy the Midco Bailer—the best in the field—at the price of most ordinary bailers or sand pumps! Price reductions were brought about through the ever increasing demand for Midco Bailers, which has enabled us to manufacture them on a larger scale, thus effecting savings in manufacturing costs which are now being passed on to operators.

Midco Bailers can be adapted to meet any requirements encountered in reconditioning work thru use of different type heads and bottoms. Its simplicity and ruggedness permits rough usage when necessary, thus eliminating the use of drilling tools for cleaning out in practically every instance, and reducing time and expense in well conditioning.

Used successfully throughout the world.

Order the Midco Bailer thru your supply store or direct as you prefer. A bulletin containing complete details and prices will be mailed upon request. Description of the Midco Bailer can be found in either the Composite Catalog or Drilling Equipment Directory, but prices are lower than shown therein.

Pat. Nos. 2061489, 2090055, 2090209

Other Patents Pending

MIDCO
BAILER CO.
1006-12 SE 29 St.
Box 1542
OKLAHOMA CITY

Geo. E. Clifford in Charge of Sales for Spang Chalfant, Inc.

Spang Chalfant, Inc., has announced the election of George E. Clifford as vice-president in charge of sales, effective August 1.

Clifford is a native of Pittsburgh, having been born and reared in Edgewood, a suburb of metropolitan Pittsburgh. He attended the Edgewood public schools and received his college training at the University of Pittsburgh. He has been with the Pipe Division of the Republic Steel Corporation since 1930, first in capacity of assistant manager of sales, and later was district sales manager of the Los Angeles, California, office. Previous to that time he was associated for five years with the sales department of the A. M. Byers Company and with Atlas Powder Company from 1919 to 1925.

GEORGE E. CLIFFORD

Clifford's headquarters will be in the general offices of the company, situated in the Grant Building, Pittsburgh.

Geochemical Service Corporation Formed

A new soil analysis laboratory, equipped to give combination chemical and geological interpretation service, has been installed by the Geochemical Service Corporation at 321 South Detroit, Tulsa, Oklahoma.

The new corporation is headed by Dr. John W. Merritt, president; R. C. Earlougher, vice-president; and L. M. Arnold, secretary-treasurer. Dr. Sylvain J. Pirson, head of the petroleum and natural gas engineering department at Pennsylvania State College, who holds a degree in mining engineering from the University of Louvain, Belgium, a master of science degree in petroleum geology from the University of Pittsburgh, and a doctor of science degree in geophysics from the Colorado School of Mines, is technical advisor to the corporation.

Hanneken and Swensrud Promoted by Standard

The election of George W. Hanneken, general manager of the manufacturing department, and Sidney A. Swensrud, head of the supply and transportation department, to vice-presidents of The Standard Oil Company of Ohio has been announced by W. T. Holliday, president.

Hanneken was born on a farm in Henry County, Missouri. In 1902 he joined The Standard Oil Company of Kansas at its Neodesha refinery as a pipe fitter helper, advancing from that position to supervisor of the cracking and coking stills. In 1917 The Standard Oil Company of Ohio instituted plans for the construction of a refinery at Toledo and Hanneken was one of those employed to take charge of the planning of the refinery layout.

With the completion of the refinery he remained in charge as superintendent. He went to Cleveland in 1936 as general manager of the manufacturing department. In his position as vice-president, Hanneken will have charge of the company's refining facilities in Cleveland, Toledo, and Lima, Ohio, and Latonia, Kentucky.

Swensrud's duties include the procurement of crude oil and other supplies, the construction and operation of crude oil and gasoline pipe lines, the coördination of refinery output with sales requirements, and the movement of refined products to sales bulk plants.

Swensrud was born on a farm near Northwood, Iowa. In 1923 he graduated from the University of Minnesota. The next two years were spent with the Washburn-Crosby Company in sales analysis work, followed by two years at Harvard School of Business, from which he graduated in 1927. For more than a year he served as a member of the faculty of the Harvard School of Business in the marketing research department. He went with the Standard Oil Company on August 1, 1928, as assistant to the president and as head of the department of business research, with special emphasis on marketing studies. With the increasing interest of the Standard Oil Company in direct crude oil purchasing, production, and pipe line transportation, Swensrud for the last several years has devoted virtually all his time to these problems.

International Exposition Extends Invitation to 26 Nations

Official word has been received by President W. G. Skelly of the International Petroleum Exposition that Greece has already selected her delegates to the May 18 to 25, 1940, show, in answer to the exposition's recent invitation to 26 oil-producing nations to exhibit and participate in the show.

Although the official invitation of the exposition was presented to the embassies of the countries only three weeks ago, G. L. Depasta, minister-counselor of Greece at Washington, D. C., wrote to say that his government has accepted.

Leslie Brooks, publicity director for the show who was sent to Washington by General Manager Wm. B. Way to contact Depasta and the ambassadors of the 25 other oil-producing nations, recently returned to Tulsa. He reports that the invitation was received with enthusiasm and that without a doubt the attendance at the 1940 International Petroleum Exposition will be the largest in its history.

The invitations are being forwarded by the ambassadors in Washington to the Bureau of Mines in each country with the recommendation that their countries be represented in the show next year.

A large portfolio invitation, including a letter from President Skelly, the resolution passed by the United States Congress inviting nations to the exposition, a picture of the proposed international building, and pictures and articles covering the show, was presented by Brooks to the foreign embassies.

Bound in purple velveteen and stamped with the name of the country to be invited and the ambassador, the invitation books will be relayed by the ambassadors to their governments, General Manager Way said.

"When I arrived in Washington," Brooks said, "Warren H. Ketchner, chief of the division of international conferences of the state department, assigned his assistant chief, Frederick Bronson Lyon, to make appointments with the embassies, and to assist me in every way possible.

"Almost every country displays a great interest in oil, and in view of this fact, all the ministers were very cordial, and genuinely interested in the show."

General Manager Way announced that James H. Gardner, president of the Gardner Petroleum Company of Tulsa, has been reappointed chairman of the international delegates committee, and that the committee will devote its efforts to procuring double the hotel space usually alloted the foreign delegates.

Foreign delegates will be taken on tours through Mid-Continent oil field, trips to shallow, deep, settled, and new production properties, and to the various refineries and gasoline plants.

Ministers and countries contacted by Brooks included:

A. de Balasy, counselor of the royal Hungarian legation; Merchant Mahoney, charge d'affaires of the Canadian legation; Ricardo Bunge, counselor of the British embassy; Sir Owen Chalkley, commercial counselor of the British embassy; Dr. Wilhelm Tannenberg, first secretary of the German embassy in charge of economic matters; Arturo Lares, secretary of the Venezuelan embassy; Jacques Dumaine, first secretary of the French embassy; B. Kleyn Molekamp, commercial counselor of the Netherland legation; Radu Irimescu, envoy extraordinary and minister plenipotentiary of Roumania; Shunichi Kase, first secretary of the Japanese embassy; Rafael Fuentes, counselor of the Mexican embassy; Count G. Roberti, secretary of the Italian embassy; M. Sirag El Din, charge d'affaires of the Egyptian legation; Alberto Vargas, secretary of the Colombian embassy; Colon Eloy Alfaro, ambassador of Ecuador; Dr. Vladimir Rybar, charge d'affaires of Yugoslavia; Eduardo Garland, counselor of the Peruvian embassy; Dr. Ali Akbar Daftary, charge d'affaires of Iran; Michal A. Budny, second secretary of the Polish embassy; G. L. Depasta, minister-counselor of Greece; Jose T. Baron, charge d'affaires ad interim of Cuba; Hon. Dr. Hu Shih, ambassador extraordinary and plenipotentiary of China; Dr. Don Luis Fernando Guachalla, envoy extraordinary and minister plenipotentiary of Bolivia; Alexander Antonovich Troyanovsky, ambassador extraordinary and plenipotentiary of the Union of Socialist Soviet Republics.

What's in a Name?

What's in a name? According to J. O. Lashar, advertising manager of American Chain and Cable Co., a great many visitors to New York World's Fair stay out of the Metals Building because they aren't interested in metals per se. The same people, he says, are interested in products fabricated from metal, like the 137 products made by American Chain and Cable Company. Accordingly, Lashar has had the word (Products) inserted in all his company advertising which calls attention to their exhibit, namely, "See our exhibit in Metals (Products) Building."

. . . *BECAUSE I'M FIXIN' to treat 'em with*

RECTORSEAL"

Operators have long sought a thread dope that would make a pressure-tight joint, and also stand up against the action of oils, dilute acids, and salt water. They have found it in RECTORSEAL, which not only makes a permanently leak-proof joint, even when threads are badly worn, but permits easy break-out.

On deep wells, particularly where large investments are tied up in long casing and tubing strings, RECTORSEAL will pay extra dividends to those operators who apply it to each joint as it is run in the hole . . . because it not only adds to the life of the threads, but positively prevents hazardous leaks.

Buy it from your supply store in container size to fit your needs.

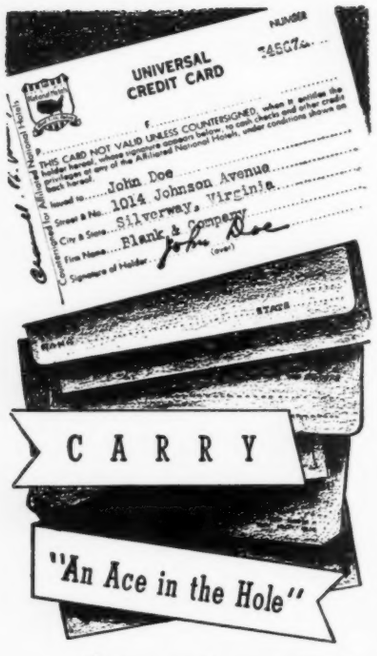
RECTOR WELL EQUIPMENT CO. INC.

Headquarters: Fort Worth, Texas

Branches:

Houston, Wichita Falls, Corpus Christi, Midland, Tulsa, Los Angeles, Shreveport, Casper

RECTORSEAL
THE POSITIVE LEAK PREVENTER



There's no need to carry a "deck" of credit cards when an "ace" will do the trick.

It is a generally accepted fact with commercial and other travelers that the "ace" among better credit cards is the National Hotel Universal Credit Card.

Why not apply for your National Hotel Universal Credit Card today? You can make your application at any Affiliated National Hotel or write:

NATIONAL HOTEL COMPANY
P. O. Box 59
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ALABAMA
THOMAS JEFFERSON ..... Birmingham

ILLINOIS
HOTEL FAUST ..... Rockford

LOUISIANA
JUNG HOTEL ..... New Orleans
HOTEL DESOTO ..... New Orleans

MISSISSIPPI
HOTEL LAMAR ..... Meridian
HOTEL RIVIERA ..... Biloxi

NEBRASKA
HOTEL PAXTON ..... Omaha

NEW MEXICO
HOTEL CLOVIS ..... Clovis

OKLAHOMA
OKLAHOMA BILTMORE ..... Oklahoma City
HOTEL HUBER ..... Muskogee
HOTEL BELMONT ..... Okmulgee
HOTEL ALDRIDGE ..... Wewoka

TEXAS
HOTEL ALICE ..... Alice
STEPHEN F. AUSTIN ..... Austin
HOTEL SETTLES ..... Big Spring
HOTEL BROWNWOOD ..... Brownwood
HOTEL SOUTHERN ..... Brownwood
HOTEL LAGUNA ..... Cisco
HOTEL CORTEZ ..... El Paso
HOTEL TEXAS ..... Fort Worth
HOTEL BUCCANEER ..... Galveston
HOTEL JEAN LAFITTE ..... Galveston
CORONADO COURTS ..... Galveston
MIRAMAR COURT ..... Galveston
HOTEL CAVALIER ..... Galveston
HOTEL LUBBOCK ..... Lubbock
HOTEL FALLS ..... Marlin
HOTEL CACTUS ..... San Angelo
ANGELES COURT ..... San Antonio

VIRGINIA
HOTEL MOUNTAIN LAKE ..... Mt. Lake

Affiliated
NATIONAL HOTELS
HOST TO THE NATION
C9-2589

I.P.A.A. Committee Named

Appointment of the Independent Petroleum Association of America's Tax Policy and Advisory Committee has been made by President Charles F. Roeser, Fort Worth, Texas. This committee is now engaged in a close study of taxes and taxation trends affecting the petroleum industry and, as in other recent years, it will present to the annual convention of the association a report with recommendations for action that the association might properly take.

W. A. Delaney, Jr., Ada, Oklahoma, is chairman of the committee and A. A. Seeligson, president of the Transwestern Oil Company, San Antonio, Texas, is vice-chairman. The other members of the committee are: E. H. Moore, president, E. H. Moore, Inc., Tulsa, Oklahoma; J. C. Hunter, Grisham-Hunter Corporation, Abilene, Texas; Al Buchanan, Al Buchanan Drilling Company, San Antonio, Texas; Fred Sehmann, secretary-treasurer, Petroleum Producers Company, Wichita Falls, Texas; Mills Bennett, Mills Bennett Production Corporation, Houston, Texas; W. M. Mattison, Guiberson Oil Company, Dallas, Texas; R. E. Parr, comptroller, Phillips Petroleum Company, Bartlesville, Oklahoma; James Dewitt May, secretary-treasury, Stodel Oil Company, Dallas, Texas; J. G. Puterbaugh, president, McAlester Fuel Company, McAlester, Oklahoma; L. M. Moffitt, president, Louisiana-Arkansas Division, Mid-Continent Oil and Gas Association, Shreveport, Louisiana; F. A. Calvert, president, Oil and Gas Association of Michigan, Saginaw, Michigan; Lloyd Williamson, manager, California Star Oil Company, Fellows, California; W. M. Fulton, Fulton Petroleum Corporation, Shelby, Montana; Hollis Watson, Wilmor Oil Company, Artesia, New Mexico; C. P. Watson, president, California Oil and Gas Association, Los Angeles, California; S. A. Yarnell, Wichita, Kansas; Gerald M. Smith, Wichita, Kansas; E. H. Balch, Barnsdall Oil Company, Tulsa, Oklahoma, and Sam J. Brill, Kendall Refining Company, Bradford, Pennsylvania.

Waukesha Motor Company Expands Mid-Continent Branch

The Waukesha Motor Company, oilfield engine builders of Waukesha, Wisconsin, have begun work on a new building at 703 South Wheeling Avenue, Tulsa, Oklahoma, to house the Mid-Continent factory branch established six years ago.

The new building is completely modern, of fire-proof construction, and will be not only air-conditioned, but sound-silenced. It comprises showrooms and offices, with connecting city order department. Personnel of the Mid-Continent branch includes sales engineers, field service engineers, and an office and shop force.

Pittsburgh Equitable Establishes European Agency

Colonel W. F. Rockwell, president of Pittsburgh Equitable Meter Company, Pittsburgh, Pennsylvania, has announced the appointment of the Anthony Bruyaux Company, Brussels, Belgium, sales agents for Pittsburgh Equitable products in Belgium, Holland, and France.

This company already is distributor of valves for the Merco Nordstrom Valve Company, a Pittsburgh Equitable subsidiary. Bruyaux, head of the firm, is well known throughout industrial Europe, and stated that in addition to his present staff, a new and larger organization will be created to serve the industries interested in the complete line of Pittsburgh Equitable products.

Appoint Distributor

The Clarence L. Boyd Company, having headquarters at Guthrie, Oklahoma, and a branch office at 17-19 West Pottawatomie, Oklahoma City, Oklahoma, has been appointed distributor for the State of Oklahoma by Bucyrus-Erie Company, South Milwaukee, Wisconsin, for the sale of Bucyrus-Erie shovels, draglines, clamshells, and lifting cranes in sizes to and including 2-yd. machines.

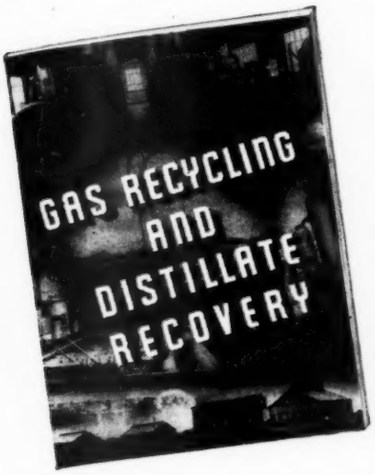
Corrections

Through error a picture of an American Askania unit was used in the Mid-year issue of *The Petroleum Engineer* as Fig. 4 of the article "Advancements in the Use of the Gravimeter in Oil Exploration" by L. M. and F. W. Mott-Smith. As the article is concerned entirely with a discussion of the Mott-Smith Gravimeter this fact is called to the attention of the reader to save confusion and in fairness to both the American Askania Corporation and the Mott-Smith Corporation.

For those who keep a file of articles that appear in *The Petroleum Engineer* attention is called to page 40 of the July issue. The word "dehydration" appearing in the head should have been "dehydrogenation." This same inaccuracy occurs in the titles of tables 5 and 6 of the same article.

Story of Gas Recycling and Distillate Recovery

Clark Bros. Company, Olean, New York, manufacturers of gas engines and compressors, have recently published a handsome booklet telling the



complete story of gas-recycling and repressuring and distillate recovery. Copies of the booklet may be obtained by writing to the company.

Union Wire Rope Appoints Four Distributors

The Union Wire Rope Corporation, Kansas City, Missouri, has announced the recent establishment of distributors at four points in New Mexico: The Myers Company at Las Cruces and Roswell, the Tucumcari Lumber Company at Tucumcari, and Hollomon Brothers at Alamogordo. George N. LeRoux, 1317 Randolph Street, El Paso, Texas, is the company's district representative in charge of this territory.

Meeting Texas Mid-Continent Oil and Gas Association, Oct. 5-7.

The 20th annual meeting of the Texas Mid-Continent Oil and Gas Association will be held at Houston October 5, 6, and 7, 1939, headquarters being at the Rice Hotel. Program details will be announced at a later date.

Officers of the association are Chas. P. McGaha, president; George C. Gibbons, executive vice-president, and Eugene McElvaney, treasurer.

Regional vice-presidents are Al Buchanan, San Antonio; H. R. Cullen, Houston; John O'Donohoe, Wichita Falls; Lynn Boyd, Pampa; Harry Adams, Midland; Art Frazier, Abilene; Bryan Payne, Tyler, and J. L. Collins, Corsicana.

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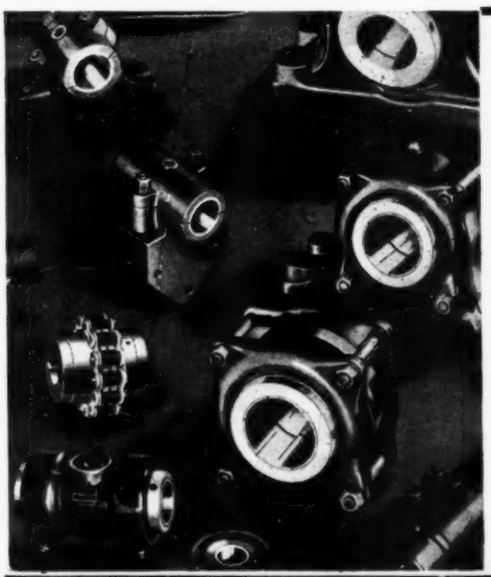

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Oil Equipment to Be Exhibited

Heavy-duty machine tools designed for the exacting requirements of oil-field work will be among those exhibited at the Machine Tool Show in Cleveland October 4 to 13, it is reported by Wendell E. Whipp, head of the Monarch Machine Tool Company, who is president of the National Machine Tool Builders' Association.

"We are expecting hundreds of men from the oil fields to visit this show," Whipp says. "During the last few years tremendous strides have been made in improvement and design of machine tools adapted to the special needs of the petroleum industry. Oil men visiting the show will find machines capable of taking punishment to an extent far beyond those of only a few years ago."

The 1939 show will be in Cleveland's Public Auditorium, and will occupy five exhibit halls having a total of more than five acres of exhibit space. Thousands of machine tools will be exhibited. More than 30,000 out-of-town visitors are expected.

Stripper Well Association Meeting Oct. 17

Program and other details of the annual meeting of the National Stripper Well Association are being planned, it is announced by Jake L. Hamon, Dallas, Texas, president of the association.

The meeting will be held in Fort Worth, Texas, October 17, at the Blackstone Hotel.

Los Angeles Nomads Elect New Members

At a meeting of the Los Angeles Chapter of the Nomads held recently at the California Country Club the following new regular members were elected:

B. Reinhold, Abegg and Reinhold Company; R. E. Gignoux, Hopper Machine Works, Inc.; Jack Walton, Emsco Derrick and Equipment Company; L. George Trembley, Howard Supply Company; Clarence Morris, *The Petroleum Engineer;* Roy Hitchcock, H & B Sales Company; George S. MacDonell, *California Oil World,* and Allen Hicks, Hydril Company.

Associate members elected were J. B. Shaw, Grant Oil Tools; Knight Templeton, Security Engineering Company, and Earle Atkins, Chiksan Oil Tool Company.

Several visitors were present from foreign oil fields, including Trinidad, Ecuador, and Venezuela. Entertainment was provided by talks and the showing of moving pictures of South America by Fred Ripley of Emsco and Clarence Wood of Oil Well Equipment Company, both of whom have recently returned from trips in South America. Of particular interest was the display of bows and arrows used by the Motilone Indians in making life miserable for oil company personnel in the Barco Concession of Colombia and along the Venezuelan-Colombian border.

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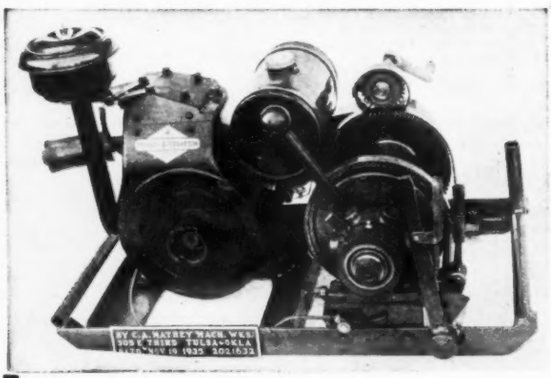

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Petroleum Employees Found to Be Safer at Work Than Off Duty

The average employee in the petroleum industry was 28 percent safer at work last year than he was when off duty, fatality figures from oil companies reporting to the American Petroleum Institute reveal.

The principal causes of off-duty deaths were highway traffic accidents and drowning. Highway accidents caused the death of 65 percent of all petroleum employees killed while off duty. Drowning caused the death of 16 percent.

"This indicates," H. N. Blakeslee, director of the Institute's Department of Accident Prevention, declares in his eighth annual report, "that employees are in need of training in driving and in conduct around bodies of water. Safety committees well may devote time and attention to discussing correct driving and promoting safe habits in swimming and boating."

The report shows that in the eight years since the Institute began reporting the causes of the industry's fatalities, the death rate has dropped 22 percent. In 1931 the fatality rate for employees in the industry was 46.9 deaths per 100,000 employees, compared with 36.6 deaths per 100,000 in 1938.

The reports upon which the Institute's industrial fatality figures are based covered 316,987 employees in 144 petroleum companies. Complete information was received on the causes of 103 of the industrial fatalities, which revealed that 49 percent of the deaths was caused by falls, falling objects, drowning, and miscellaneous causes; 35 percent was due to fires and explosions; 12 percent involved trucks and automobiles; three percent was from electrical contacts, and one percent was due to asphyxiation.

Commemorate Discovery Well in Permian Basin Oil Area

Plans are being made for the first annual celebration of the discovery of oil in the Permian Basin, Texas, to be held August 24 and 25, next, at Colorado City, Texas. Oil men, business men, and landowners are developing the project, and it is planned to hold a celebration annually, each time at a different place.

Leading in development of the project are Frank Kelley, Magnolia Petroleum Company, Colorado City, Texas, and R. J. Wallace, chairman of the Celebration Committee, and H. B. Spence, manager of the Colorado Chamber of Commerce at Colorado City. It is planned also to organize a West Texas and New Mexico Permian Basin Oil and Gas Association.

Petroleum Geologists to Meet in Chicago

The 25th annual meeting of the American Association of Petroleum Geologists will be held at the Stevens Hotel, Chicago, Illinois, April 10, 11, and 12, 1940, under the sponsorship of the Illinois Geological Society.

The officers of the association are Henry A. Ley, Southern Cross Oil Company, San Antonio, Texas, president; L. Murray Neumann, Carter Oil Company, Tulsa, Oklahoma, vice-president; E. W. Owen, L. H. Wentz, Inc., San Antonio, Texas, secretary-treasurer, and W. A. Ver Wiebe, University of Wichita, Wichita, Kansas, editor.

Refinery Specifications Revised

Specifications for flanged steel outside-screw-and-yoke wedge gate valves published as tentative by the American Petroleum Institute early in 1938 have been revised slightly and adopted as standard in their revised form as Standard No. 600A-39. The price of single copies is 50 cents.

Death Calls Stanley P. Brown, General Manager, Hughes Tool Company

The entire petroleum industry was grieved to learn of the death of Stanley P. Brown, vice-president and general manager of the Hughes Tool Company, Houston, Texas. Brown became ill with pleurisy July 25 and entered a Houston hospital, passing away on the morning of August 11. He was 47 years old and had been connected with the company 20 years.

S. P. BROWN

Brown was a second lieutenant in the United States Aviation Corps during the World War. In 1919 he became a mechanic's helper with the Hughes Tool Company, later becoming a salesman, and two years from the time he was first employed was made sales manager. He held the post of sales manager for 13 years, during which time he traveled extensively and gained much valuable information on oil fields in North and South America. In 1934 he became vice-president of the company, retaining, however, the sales managership. On April 1 of this year he was promoted to general manager when Colonel R. C. Kuldell, who had headed the company for nearly 20 years, resigned.

Carl Joys, Jr., Resigns From A. O. Smith Corporation

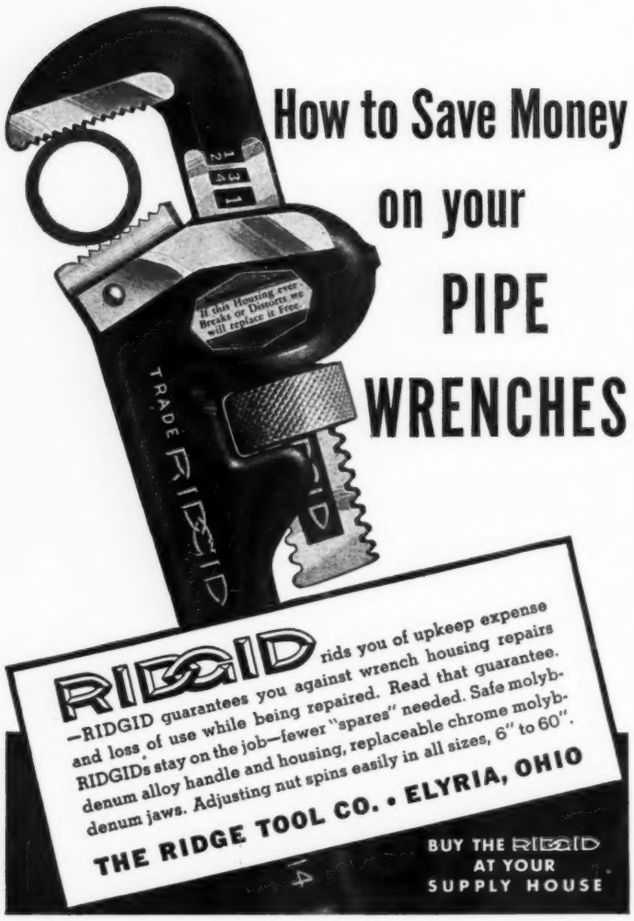
Carl Joys, Jr., vice-president and director of the A. O. Smith Corporation, Milwaukee, Wisconsin, has announced his resignation, effective September 1. Joys has been connected with A. O. Smith since August 1, 1924, when the company entered the oil-field market with electric-welded pressure vessels. He has been directing the sales of all the company's products for this market since. He became a director of the corporation in 1927 and has been a vice-president since 1935.

CARL JOYS, JR.

Prior to joining A. O. Smith Corporation, Joys gained oil-field experience in California and held various sales positions in executive capacity. Joys, when asked, stated he was not at liberty to disclose his future plans at this time. No announcement of a successor has been made by the company, and it is not expected that the position left vacant by his resignation will be filled immediately.

H. S. Kern to Oklahoma City

Hal S. Kern, hydraulic engineer, for many years associated with the Peerless Pump Division of the Food Machinery Corporation in Los Angeles, California, has been transferred to Oklahoma City, Oklahoma, to personally supervise installation of Peerless Pumps in refineries and on leases. Kern will make his headquarters at The Shuler Company in Oklahoma City.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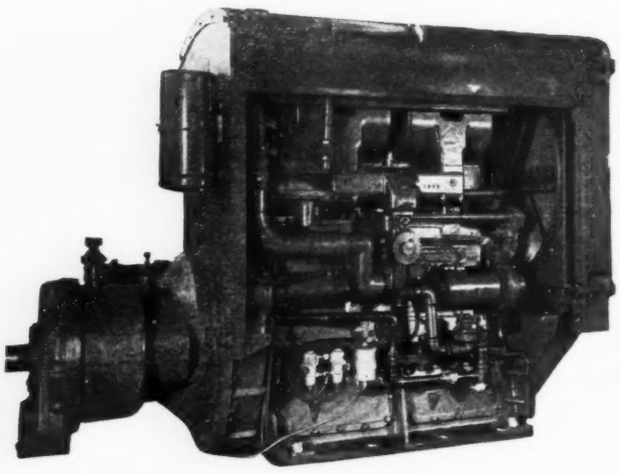

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Houston Oil Show Declares Refund

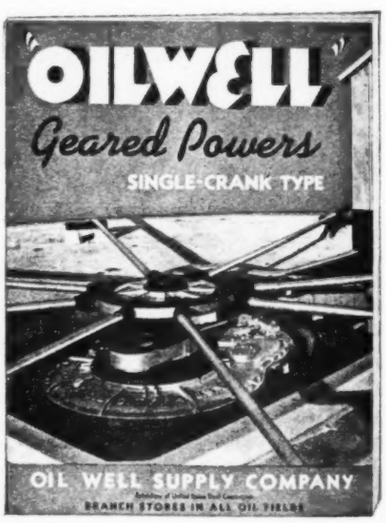
In accordance with the non-profit policy of the Oil-World Exposition, Inc., a refund of 10 percent has been made to all exhibitors who had space in the 1939 Exposition at Houston in April.

The date for the next Oil Show in Houston has been set as April 11 to 18, 1942. Contracts for this Exposition are already being signed and more than $8000 worth of space has been sold to date. At a meeting of the board of directors it was decided to give an option to exhibitors in the 1939 Show for the same space in the 1942 Show. This option will be granted until January 1, 1940, and all space not sold at that time will be assigned to applicants for the space in the order in which applications are received.

Definite action on the 1942 Exposition was taken after the City of Houston offered to provide additional grounds, buildings, and other facilities that will be necessary to assure complete success of the next Show. The greater facilities thus assured made unnecessary the purchase of buildings and grounds for the purpose of holding the next Exposition in Houston although the directors have expressed their willingness to coöperate with anyone who wishes to erect buildings and provide complete facilities for Exposition purposes.

"Oilwell" Geared Power Bulletin

Forty-five illustrations are included in a new bulletin descriptive of Oil Well Supply Company's complete line of geared powers. Outstanding for its thorough coverage of the subject, this bulletin consists of 16 pages and a cover, and is printed in two colors throughout.



One photograph of special interest shows five sizes of "Oilwell" geared powers on display in 1898. On the same two-page spread "Oilwell's" five sizes of modern, single-crank, enclosed, geared powers are presented. These range from 30 to 150 hp. in oil-country rating.

Two-color diagrammatic sketches and sectional views are used to show the "Oilwell's" stationary-spindle construction and other features. Various types of applications are illustrated by actual installation photographs and also by dimensional drawings. A convenient selection chart makes it easy for an operator to choose the size power that is best suited to his particular requirements.

Copies of this bulletin may be obtained without obligation at any "Oilwell" store or office or by writing to Oil Well Supply Company, Dallas, Texas. The manufacturer requests that you mention *The Petroleum Engineer* when sending for a copy of the bulletin.

Committees Named for Eastern District Meeting of A.P.I.

D. T. Ring, chairman, has announced the appointment of the following committees for the 1940 Spring Meeting at Columbus, Ohio, April 11 and 12, of the Eastern District of the Division of Production, American Petroleum Institute:

Program Committee: J. J. Schmidt, chairman, East Ohio Gas Company, Cleveland, Ohio; Gordon M. Gulley, Gulf Oil Corporation, Pittsburgh, Pennsylvania, and R. W. McIlvain, Jr., The Pure Oil Company, Olney, Illinois.

Registration Committee: J. C. Askam, chairman, The Ohio Oil Company, Findlay, Ohio; I. W. Hartman, Gordon Oil Company, Mt. Pleasant, Michigan; T. H. Myers, Carnegie Natural Gas Company, Pittsburgh, Pennsylvania, and H. A. Sprowls, Kentucky Natural Gas Corporation, Owensboro, Kentucky.

Publicity Committee: O. W. Van Petten, chairman, Columbian Carbon Company, Charleston, West Virginia; Philip N. Faine, Ohio-Pennsylvania Grade Oil Producers Association, New Straitsville, Ohio; H. M. McClure, State Conservation Committee, Alma, Michigan; J. A. Thompson, Belmont Quadrangle Drilling Corporation, Bradford, Pennsylvania, and Wm. A. Watkins, The Carter Oil Company, Mattoon, Illinois.

Arrangement and Entertainment Committee: W. E. Ferguson, chairman, The Ohio Fuel Gas Company, Columbus, Ohio; E. V. O'Rourke, The Ohio State University, Columbus, Ohio, and Lester Woltz, Oil Well Supply Company, Columbus, Ohio.

Plans Completed for Appalachian Meter School

H. J. Wagner, senior natural gas engineer, Public Service Commission of West Virginia and chairman of the Meter School Committee, has announced that all is in readiness for this year's Appalachian Gas Measurement Short Course to be held at the University of West Virginia in Morgantown, August 21, 22, and 23.

Oustanding speakers have been procured for the various sessions. General meetings will be held in the morning on Monday and Tuesday at which time those present will be addressed by recognized authorities on various economic phases of gas measurement and control. These speakers include Dr. C. E. Lawall, acting president of the University of West Virginia; W. A. Wallace, Jr., president of the Oil and Gas Association of West Virginia; George E. Welker, president, United Natural Gas Company; C. C. Phillips, superintendent of transmission, Ohio Fuel Gas Company; B. L. Maulsby, manager, Lynchburg Gas Company; A. M. Hutchinson, superintendent of gas measurement, Ohio Fuel Gas Company, and C. C. Reed, general superintendent, Hope Natural Gas Company.

Classroom sessions of one hour and fifteen minutes each will be conducted afternoons and all day Wednesday by gas company engineers and representatives of equipment manufacturers. A wide variety of subjects will be offered during each period from which a choice may be made. Repeat classes are scheduled to provide for conflictions in interest.

The following firms have been invited to participate with exhibits and have representatives scheduled to conduct classes: Pittsburgh Equitable Meter Company, American Meter Company, Chaplin-Fulton Manufacturing Company, Tomlinson Steam Specialty Company, Mellon Institute, Foxboro Company, Reynolds Gas Regulator Company, The Meriam Company, Sprague Meter Company, Roots-Connersville Blower Company, Fisher Governor Company, The Refinery Supply Company, Reliance Regulator Company, and the Bristol Company.

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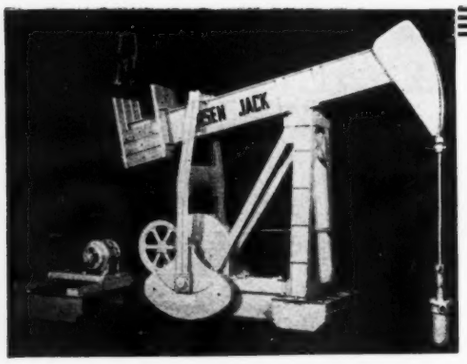

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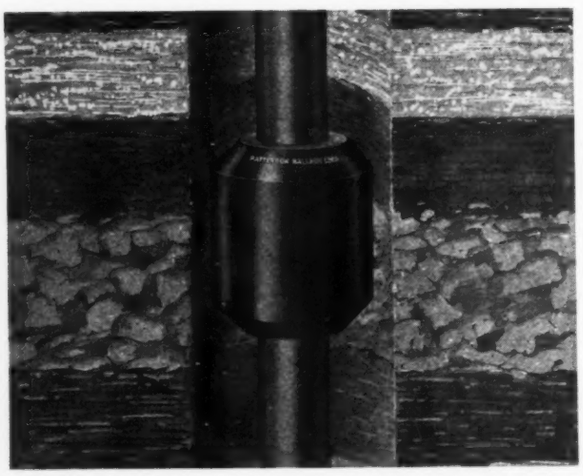

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Operators claim that the use of these new Stabilizers reduces sticking of drill pipe by keeping the walls of the hole from caving. They say: "Whip is reduced to such an extent that it is shown on the 'Torque Gauge' to have reduced friction as much as 50 per cent. Kinked joints are a thing of the past." Ask for further details.

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Book Reviews

Petroleum Production Engineering—Oil Field Exploitation by Lester Charles Uren, Second Edition, 1939. Published by McGraw-Hill Book Company, New York, N. Y. 756 pp. 386 figs., 37 tables. Price $6.00.

This volume, complete in itself, complements the author's *Petroleum Production Engineering—Oil Field Development.* Written by one of the foremost authorities on production practices, the entire work is a masterpiece to which engineers and executives of the petroleum industry may turn for up-to-date, reliable information. The chapters on oil drainage, lifting methods, management of wells, and secondary methods of recovery constitute the most detailed and comprehensive treatment of these subjects yet published. Each step of the production process, from completion of wells to transportation of the products to market, is carefully outlined in these 12 chapters: 1. Principles of Oil Drainage; 2. Flowing Wells and Their Control; 3. Pneumatic Pumping of Oil Wells; 4. Mechanical Devices for Lifting Oil from Wells; 5. Management of Wells to Secure Maximum Recovery; 6. Secondary Methods of Oil Recovery; 7. Preliminary Refining of Petroleum: Dehydration; Separation of Gas and Suspended Solids; 8. Gathering, Local Storage and Shipping of Petroleum; Gaging, Sampling and Testing of Oil and Gas; 9. Storage of Petroleum; 10. Transportation of Oil and Gas; 11. Auxiliary Plants and Departments on the Oil-producing Property; 12. Office Methods and Records.

* * *

Mexico at the Bar of Public Opinion by Burt M. McConnell. Published by Mail and Express Publishing Company, New York, N. Y., 1939.

For those interested in Mexico's so-called expropriation of oil properties, this book offers a convenient source of information on the progress of events and the reaction of opinion as expressed by the various newspapers of the United States. It is essentially a compilation of editorials that have appeared on the subject.

In the words of the author, "These editorials must be accepted at their face value. They are independent, unbiased observations of trained writers. They truly represent national opinion, for they are taken from newspapers published all over the nation. The text thus presents a national, rather than a partisan, sectional, or group viewpoint."

* * *

A.P.I.-A.S.M.E. Code—Unfired Pressure Vessels for Petroleum Liquids and Gases. Third Edition. Published by Joint A.P.I.-A.S.M.E. Committee on Unfired Pressure Vessels, 50 West Fiftieth Street, New York, N. Y. 198 pp., 1938.

This volume includes the latest revisions and additions to the code established for the design, construction, inspection, and repair of fusion-welded, riveted, and integrally forged pressure vessels intended to contain petroleum liquids or gases. Appendixes include materials, suggested good practices, examples of computations, form of manufacturer's report of welding test, and form of inspection record. Significance of the section on inspection and repair cannot be too strongly emphasized, as failure to comply with its provisions would vitiate the efforts of the designer and fabricator to prepare equipment that could be used with safety. The book should be a useful guide for anyone making, selecting, or using this type of equipment.

Trade Literature

SUMMER WEATHER DATA is an unusually well-written text and reference book, compiled in a compact form, presenting data vital to accurate design of cooling towers, heat exchangers, and other equipment depending upon atmospheric and weather conditions.

A tremendous amount of work has gone into the analysis and preparation of the comprehensive weather information included in the book. Detailed statistical data are given covering 200 selected cities throughout the nation, dealing with dry bulb temperatures, wet bulb temperatures, wind performance, and other factors pertinent to engineering design.

In addition to the statistical tables, the text included presents an excellent discussion of the significance of each phase of the material as it pertains to the proper selection of equipment in a given locality.

The book, compiled and edited by J. C. Albright, may be obtained from The Marley Company, Fairfax and Marley Roads, Kansas City, Kansas. The price is $3 per copy. The company has prepared Bulletin 802, containing a reprint of one of the chapters of the book, which will be sent free of charge to anyone interested.

* * *

McGILL MANUFACTURING COMPANY, Valparaiso, Indiana, has issued a bulletin describing a new development by its engineers, the "Solidend" Multirol Bearing. Copies of the bulletin will be sent free to interested parties.

* * *

C. J. TAGLIABUE MANUFACTURING COMPANY, Brooklyn, New York, has issued its new pyrometer and resistance thermometer Catalog No. 1101E. The following recent developments have never before been cataloged:

1. Self-balancing indicating controller.
2. Self-balancing indicator with "in balance" signal.
3. Recorder-controller for throttling fuel heat.
4. Recorder-controller for throttling electric heat.
5. Two point indicating controller.
6. Multiple point (to 6) indicating controller.
7. Cabinet type indicator.

* * *

AN INTERESTING 48-page illustrated brochure, attractively bound, portraying the important part that production cleaning and its related operations play in America's leading industries, has been issued by Oakite Products, Inc., New York, in connection with its 30th year anniversary.

Among the 40 different industries featured is included power, petroleum, railroad, street railway, and bus transportation. The text matter is concise and contains much statistical and historical data bearing on the contributions made by American industry to the nation's economic progress.

* * *

A NEW BULLETIN listing descriptions, illustrations, and prices of its products has been issued by the Kibele Manufacturing Company, Dallas, Texas. Of special interest is the material on the Kibele Valve-in-Head Packer, printed for the first time. This item was put on the market in 1938.

* * *

LINK-BELT COMPANY has published a 272-page book, No. 1600, which it announces as a new handbook of modern power transmission units, containing complete design and application data, dimensions, weights, list prices, cross-indexed for the convenient use of design engineers and plant managers. A copy will be sent to any interested party upon request addressed to Link-Belt Company, Chicago, Philadelphia, or other office of the company.

KINK OF THE MONTH "in the interests of more efficient cleaning"

HEAT EXCHANGE EQUIPMENT NOW CLEANED FASTER

To get rid of those sludge deposits that so seriously cut down the heat transfer capacity of your exchangers, put efficient, economical Oakite cleaning to work for you.

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Representatives in all principal cities of the United States.

OAKITE 1909 1939 30

OAKITE certified CLEANING
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

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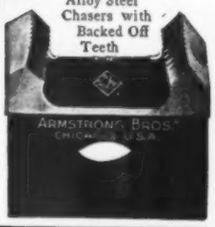
ARMSTRONG BROS.

Adjustable DIES *and ...* STOCKS

Alloy Steel Chasers with Backed Off Teeth



Cut faster, easier; cut *smooth threads*. Dies are Chrome-Vanadium Steel, have backed-off teeth, correct Cutting Angle, correct Throat Angle and Ample Chip Clearance.
Free from ridges and corners. Stocks fit comfortably in hand, are balanced, are accurately machined inside. Take all dies.

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HOLLIS H. HODGES MANAGER

TULSA, OKLAHOMA

Parkersburg Announces Changes in Sales Personnel

The Parkersburg Rig and Reel Company has announced several changes in the sales personnel of its organization, effective August 15.

H. L. Dickson, who has been stationed in Tulsa, Oklahoma, as district manager for the Oklahoma-Kansas District, has been transferred to the general sales office at Dallas, Texas.

E. L. Byer, who has been serving in the St. Louis, Missouri, office as district manager for the North Central District, has been transferred to Tulsa where he will be in charge of sales in Oklahoma, Kansas, Missouri, Illinois, Indiana, and Western Kentucky.

J. M. Baldridge, who has been serving as branch manager at Kilgore, Texas, has been moved to St. Louis, Missouri, where he will serve as assistant district manager for Illinois, Indiana, and Western Kentucky.

Baroid Acquires Drilling Mud Firms

Baroid Sales Department, National Lead Company, has announced the acquisition of the drilling mud business of the Geo. S. Mepham Corporation and C. K. Williams and Company of California. Baroid is now offering to the trade, in addition to its former products, those previously manufactured by the Mepham and Williams companies. The latter include Colox, Jelox, and "Chemical Z."

Hercules Motors Extends Oil-Field Operations

Hercules Motors Corporation, Canton, Ohio, has recently completed arrangements for permanent representation in the Illinois oil fields. In addition, direct factory representation has been established in the Dallas, Texas, area, supplementing the activities of the Hercules branch stores previously opened at Houston and Kilgore, Texas.

All Mid-Continent sales and service activities are under the direction of A. B. Wehling, who has headquarters at the Houston branch. Fred Goldsmith, previously at Houston, has established Dallas headquarters at 4130 Prescott Avenue. Russell J. Scott, also formerly connected with the Houston branch, has established headquarters at 418 North Ninth Street, Mt. Vernon, Illinois.

Adds to Sales Staff

The McEvoy Company since reorganization has added six salesmen to its force. J. B. Durkee will contact supply houses at Tulsa, Oklahoma, Dallas, Texas, Shreveport, Louisiana, and San Antonio, Texas. B. G. Johnson will serve the trade in Houston, Texas, and vicinity. G. S. Watson, Jr., is stationed in the West Texas field. J. L. (Slim) Hickman has headquarters in Victoria, Texas, and will contact the South Texas trade. Fred Henslee is stationed in Louisiana, and Hiram Grantham specializes on the company's water well equipment.

Link-Belt Speeder Corporation Organized

Announcement is made by Alfred Kauffmann, president, Link-Belt Company, Chicago, Illinois, that the company has organized the Link-Belt Speeder Corporation, a wholly-owned subsidiary but operated independently, with headquarters at 301 West Pershing Road, Chicago, for the manufacture and sale of power-operated excavating and materials-handling shovels, draglines, and cranes, including a full line of track-type locomotive cranes.

MEETINGS

California Natural Gasoline Association—September 7, Richfield Building, Los Angeles, California.

Appalachian Gas Measurement Short Course—August 21, 22, and 23, Morgantown, West Virginia.

American Society of Mechanical Engineers—September 4, 5, 6, 7, and 8, New York, New York.

American Chemical Society—September 11, 12, 13, 14, and 15, Boston, Massachusetts.

National Petroleum Association, Annual Meeting—September 13, 14, and 15, Traymore Hotel, Atlantic City, New Jersey.

American Institute of Mining and Metallurgical Engineers, Petroleum Division—October 4, 5, and 6, Galveston, Texas.

Western Petroleum Refiners Association, Regional Technical Meeting—October 5, Allis Hotel, Wichita, Kansas.

Texas Mid-Continent Oil and Gas Association, Annual Meeting—October, 5, 6, and 7, Houston, Texas.

American Gas Association, Annual Convention—October 9 and 10, New York, New York.

National Safety Congress and Exposition—October 16, 17, 18, 19, and 20, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

Independent Petroleum Association of America, Tenth Annual Meeting—October 18, 19, and 20, Fort Worth, Texas.

American Institute of Mining and Metallurgical Engineers, Petroleum Division—October 19 and 20, Los Angeles, California.

Western Petroleum Refiners Association, Regional Technical Meeting—October 27, Washington-Youree Hotel, Shreveport, Louisiana.

American Petroleum Institute, 20th Annual Meeting—November 13, 14, 15, 16, and 17, Stevens Hotel, Chicago, Illinois.

American Institute of Chemical Engineers—November 15, 16, and 17, Providence, Rhode Island.

American Society of Mechanical Engineers—December 4, 5, 6, and 7, Philadelphia, Pennsylvania.

American Association of Petroleum Geologists, Annual Meeting—April, 10, 11, and 12, 1940, Stevens Hotel, Chicago, Illinois.

American Petroleum Institute, Eastern District, Division of Production—April 11 and 12, 1940, Columbus, Ohio.

National Petroleum Association, Semi-Annual Meeting—April 18 and 19, 1940, Cleveland Hotel, Cleveland, Ohio.

International Petroleum Exposition—May 18, 19, 20, 21, 22, 23, 24, and 25, 1940, Tulsa, Oklahoma.

Third World Petroleum Congress—June 9, 10, 11, 12, 13, 14, and 15, 1940, Berlin, Germany.

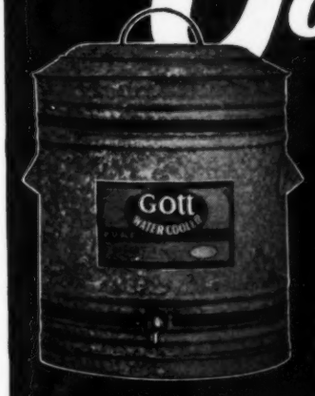
Chiksan Names Crane Co. Distributor

Crane Co. has been appointed national distributors of Chiksan products, according to Earle R. Atkins, sales manager, Chiksan Oil Tool Company, Fullerton, California. In addition to swing joints, Crane Co. will distribute barge and dock hose, and other Chiksan products incorporating swing joints.

In making this announcement, Atkins points out that the Chiksan Oil Tool Company will maintain its staff of sales representatives in principal cities, as in the past, and will continue its sales and service organization in the oil fields for all-steel rotary hose, circulating heads, disk bits, reamers, mud guns, etc.

Gotkool

WATER CANS & COOLERS



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Made in 3, 5, 8, 10, and 20 gallon sizes.

GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today!

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The Scientific TREND!

"The Entirely Different Boiler and Engine Treatment"

The ready acceptance of Sand-Banum by the oil industry is another indication of the "overwhelming trend toward the utilization and application of science and engineering skill."*

This pure colloidal concentrate is "The Modern Way" and "Tomorrow's Way" of controlling all scale and corrosion troubles in boilers and engines—regardless of the operating conditions or the nature of the water used! It comes in 16-ounce cans—ready to use. Each can safely protects a 50 hp. boiler for a month. Operators everywhere know its unusual convenience and economy!

TEST IT FIRST—Then pay for it. Try Sand-Banum in your own equipment for 30, 60 or 90 days. Then if you are not satisfied with results—*you pay us nothing!*

**Petroleum Engineer Editorial, Midyear, 1939*

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Alloy Steel Studs
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For an ELEPHANT

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To Meet Every Condition

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With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.

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Used when tools are run and when well is shot to quickly remove loose material.

● STAR BOTTOM

Used for cutting the sand loose.

● CHISEL BOTTOM

(In Pump)

With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

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See Pages 1564-65 COMPOSITE CATALOG

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